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Report of the Advisory Board

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TRENTON, NEW JERSEY

to the

New Jersey State Highway Commission

VEHICULAR TUNNEL TRAFFIC STUDY

Recommendation for Methods of Handling Traffic in Jersey City and Vicinity Incident to the Construction of the Vehicular Tunnel Between New York and New Jersey

ADVISORY BOARD MEMBERS

W. G. Sloan, *Chairman*
T. J. Wasser
R. P. McClave
W. A. Stickel
Chas. VanKeuren
E. P. Goodrich
Consulting Engineer
C. M. Holland
J. W. Costello
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Trenton, N. J.
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TRENTON, New Jersey, August 8, 1923.

To the State Highway Commission of New Jersey, Trenton, New Jersey:

GENTLEMEN—In accordance with the action of your Board at its meeting on May 11th, 1923, I have to advise that the Advisory Board has carefully considered the problems submitted to them by you, concerning the proper handling of the volume of traffic in the vicinity of Jersey City, and taking into consideration the increase in such traffic which will be occasioned by the construction of the Vehicular Tunnel between New York City and Jersey City.

The Board has embodied the result of these studies in a written report and the conclusions and recommendations embraced therein cover, in the opinion of the Board, the best method of handling this most unusual traffic situation.

The report is submitted herewith.

Respectfully submitted,

W. G. SLOAN,

Chairman.

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ORGANIZATION OF ADVISORY BOARD.

Resolution.

The State Highway Commission, under date of May 11, 1923, adopted the following resolution appointing an Advisory Board for the study of the Vehicular Tunnel Traffic:

"WHEREAS, The importance of the project of taking care of the traffic from the entrance of the Hudson River Vehicular Tunnel at Jersey City, and its distribution through Jersey City and Newark, and points north, west and south, throughout the State, is such as to require a special study; therefore,

"Be It Resolved, That the State Highway Commission does hereby appoint an Advisory Board for the special study of this problem, the said Advisory Board to be composed of Major W. G. Sloan, State Highway Engineer, as Chairman; Mr. E. P. Goodrich, Special Consulting Engineer, and Charles Fishberg, Secretary to said Board; the Chief Engineer of the Bridge and Tunnel Commission; the County Engineers of the counties of Hudson, Bergen and Essex; and the City Engineers of the cities of Jersey City and Newark; and

"Be It Further Resolved, That the Tunnel Commission, the Boards of Freeholders of the counties of Hudson, Essex and Bergen, and the authorities of the cities of Jersey City and Newark, be requested to designate their engineers as members of this Advisory Board, it being understood that the said Advisory Board with the exception of the Consulting Engineer and Secretary will give their services to the State without remuneration other than their necessary expenses, in view of the public good to be derived from such work, the technical report to be submitted to the State Highway Commission; and

"Be It Further Resolved, That the duties of the said Advisory Board shall be to study the problems presenting themselves in connection with the expeditious and economical handling of the volume of traffic which will converge to and diverge from the entrance to the vehicular tunnel in Jersey City throughout the zone in which points of congestion due to such traffic may occur; to give consideration not only to the probable character and amount of traffic to be expected at the time of the opening of the tunnel, but also its future character and amount; to devise plans for handling such probable traffic in accordance with the above, such plans to embrace the location of routes and types of construction; to compile the results of the above work in a report to be furnished to the State Highway Commission."

PERSONNEL OF BOARD.

Acting upon the call of your State Highway Engineer, as Chairman, the first meeting of this Advisory Board was held on May 17, 1923, with all members present as follows:

W. G. Sloan, State Highway Engineer, *Chairman;*
E. P. Goodrich, Consulting Engineer;
C. M. Holland, Chief Engineer, Tunnel Commission;
T. J. Wasser, Hudson County Engineer;
R. P. McClave, Bergen County Engineer;
W. A. Stickel, Essex County Engineer;
J. W. Costello, Newark City Engineer;
Chas. Van Keuren, Jersey City Engineer;
Charles Fishberg, *Secretary.*

MEETINGS OF BOARD.

Meetings of the Advisory Board were held as follows:
Thursday, May 17th, City Hall, Jersey City.
Wednesday, June 6th, Court House, Jersey City.
Wednesday, June 27th, Interstate Bridge & Tunnel Commission offices, New York.
Wednesday, July 11th, Court House, Jersey City.
Wednesday, July 18th, City Hall, Newark.
Wednesday, July 25th, Court House, Newark.

Inspections. Inspections were made by the Advisory Board members of the several possible routes to be considered, before having surveys made.

Engineering parties were put into the field to make surveys of the physical conditions to be encountered in the construction of the necessary highways, and traffic counts were made at important points to ascertain the present traffic, and such records as were available of traffic conditions existing during the past ten years were carefully examined in order that the tendency of traffic development might be determined, and as far as possible projected into the future.

GENERAL POLICIES.

Assumptions.

The recommendations made herein are based on the following assumptions which we believe are consistent with the wording of the resolution as passed by the State Highway Commission, and in accordance therewith:

1. The limits of the territory in each direction from Jersey City, which is to be embraced in this report, are determined by the probability of present or future traffic developing to a point where congestion may be reached at such time as the traffic through the tunnel shall have reached the capacity of the tunnel.

2. The location and type of construction to be used is to be the best which would be justified by the present or future traffic, giving due weight to:

(a) the economical grades;
(b) the elimination of curvature;
(c) the elimination of grade crossings, both as regards street and rail roads;
(d) the elimination of draw bridges;
(e) other considerations affecting the facility and safety of travel.

Each of the above points at any particular location is studied in connection with the cost of securing the result desired, and the proper selection of route and construction being determined on the assumption that the State Highway Commission desires information as to the cost of such best location and type of construction.

3. Recommendations are also based on consideration of the improvement as a comprehensive unit, and where it might appear that within certain localities particular requirements and desires of that locality have not been met, yet such considerations have had due weight in making the recommendations for what, in the opinion of the Advisory Board is the best solution of the whole problem.

NECESSITY FOR A COMPREHENSIVE PLAN AND STUDY.

Early Decisions.

The early investigations of the Board made it apparent that a comprehensive plan covering highway construction over a considerable area would be necessary in order to provide for facilities to handle the volume of traffic which it was evident would be developed during the period under consideration, and further that advantage must be taken of all routes and methods of construction which would permit of the handling of this volume of traffic with a maximum of safety, minimum of delay, and the greatest economy.

GEOGRAPHICAL LIMITS OF INVESTIGATION.

Traffic South and Southwest.

The handling of the traffic which would use the highways leading to the west and southwest of Jersey City, particularly Routes Nos. 1 and 9 of the State Highway System, including the inter-state traffic to and from the metropolitan district, presented the greatest problem. The volume of traffic over these routes is at the present time very heavy and the opening of the vehicular tunnel will increase it to a very great extent.

Congested Points.

Congestion at the present time occurs in Newark and Elizabeth, and it was decided by the Board that such reconstruction or building of new highways as is necessary to eliminate these points of congestion must be included in the recommendations.

Traffic North and Northwest.

Traffic to the north and northwest, embracing the Paterson-Hackensack District is, and probably will continue to be, considerably less in volume than that to the south and southwest. It is believed that this traffic will be taken care of by the construction or improvement of short connecting links in Jersey City, to reach the existing highways across the meadows and to connect with State Highway Route No. 18, when that route is constructed. The construction involved in order to

accomplish this will include the widening and improvement of certain streets on the low level in Jersey City to connect the primary route with Hoboken, and the construction of a highway from a point where the primary route crosses Tonnelle Avenue to connect with the above mentioned highways across the meadows and with Route No. 18.

Paterson Plank Road.

The Paterson Plank Road may require improvement at some later date, involving an expense of approximately $450,000.00.

Bergen County Traffic.

These are several highways over which travel, coming through Bergen County, will endeavor to reach the tunnel. At the present time, Bergen County has a State Highway, known as Route No. 10, running from Paterson to the Fort Lee Ferry by way of Dundee Lake and Hackensack. This highway is located at about a third point between the Hudson County line and the New York State Line. There are two other routes, namely Route No. 17 and Route No. 18, which are in the State Highway System, but which have not been taken over by the State Highway Commission.

Route No. 17.

Route No. 17 starts at the southwest corner of the County and runs in a northerly direction to Hackensack and thence continues in a northerly direction through Hackensack to Suffern. Over this route at the present time there is a large percentage of New York State traffic.

Route No. 18.

Route No. 18 is located on the easterly side of the County and runs at the bottom of the westerly side of the Palisades from the Hudson County Line northerly to Route No. 10, and on the easterly side of the top of the Palisades from Route No. 10 northerly to the New York State line connecting with what is termed New York State Highway Route No. 3.

Route No. 10.

At the present time, Route No. 10 is constructed to Hackensack with the exception of the westerly approach to the Palisades from Ridgefield to Fort Lee. This

section is now under construction and the route will, therefore, be complete from the Fort Lee Ferry to Hackensack by the end of 1923. The section from Hackensack to Paterson is in poor condition and should be placed under construction at as early a date as possible, for were this route constructed, the traffic from the north and south County feeders leading into Route 10 will be intercepted and the traffic in this event could follow Route No. 10 to Ridgefield, and from Ridgefield could continue southerly on Route No. 18 to Tonnelle Avenue in Jersey City, thence along Tonnelle Avenue to Route No. 1, and thence through Route No. 1 to the tunnel.

Route No. 18 with the completion of Route No. 3 of the New York State System, will receive traffic from New York State or carry the traffic through New York State to West Point and points beyond, along the Hudson River. An extension of Route No. 18, southerly along Palisade Avenue in the Borough of Fort Lee and Cliffside Park, to either the Hudson County Boulevard or to Park Avenue, would be desirable, and in this event light traffic will be enabled to use the Boulevard as an approach through Hoboken or the western Boulevard in Hudson County to the tube entrance.

Route No. 17 will play an important part as a feeder artery to the tunnel due to the fact that its northerly terminus, Suffern, N. Y., is the outlet of one of the principal New York State Highway routes carrying through travel.

In order to control a means of travel through the lower section of the County, it may be desirable that the Paterson Plank Road, both in Bergen and Hudson counties be proposed as a highway route for special legislation. This highway now carries a great traffic from the big industrial sections of Passaic County and the travel in this particular section must necessarily cross the meadows on this highway.

Bayonne Traffic.

The facilities already afforded by city streets should take care of traffic to reach Bayonne.

Summary.

In accordance with the above, therefore, the geographical limits of this report confine themselves to Jersey City, a point to the southwest in the City of Elizabeth, and a point to the north on Route No. 10, near Ridgefield, as shown on the attached keymap. Consideration has also been given to the proposed construction by the railroad companies of large terminal storage yards and warehouses, as contemplated in connection with Port development plans now being worked out, and due to which there will be created a very large amount of truck traffic which will use the vehicular tunnel.

Proposed Terminal Yards.

SURVEYS MADE OF PRESENT TRAFFIC.

The following traffic information was obtained by the Board:

Traffic Counts Taken.

1. Traffic counts were taken on each road leading into Jersey City, the results of which were combined with similar information furnished by the office of the County Engineer of Hudson County, covering a period of four years and adjusted for seasonal variations.

2. Records of traffic counts on Newark streets were obtained from the City Engineer of Newark.

3. Records of traffic counts in Bergen County were obtained from the County Engineer of Bergen County.

4. The New Jersey Interstate Bridge and Tunnel Commission has made careful study of the ferry traffic extending from 1919 to date. Prior to their undertaking this work, the Public Service Corporation of New Jersey had studied the ferry traffic from 1913. In summarizing and clarifying the data, the ferries were divided into groups, the first group consisting of the five ferries nearest the tunnel, from which it is expected the greatest part of the tunnel traffic would be diverted, and which, as the figures show, handle approximately

Five Ferry Group.

49 per cent of the total ferry traffic. This group is referred to as the "Five Ferries," namely:

Penna. R. R.—Desbrosses Street.
Penna. R. R.—Cortlandt Street.
Erie R. R.—Chambers Street.
D., L. & W. R. R.—Barclay Street.
D., L. & W. R. R.—Christopher Street.

Six Ferry Group.

The second group consists of six ferries, farther from the tunnel, and embraces 27 per cent of the total ferry traffic. This group is referred to as the "Six Ferries," namely:

C. R. R. N. J.—Liberty Street.
C. R. R. N. J.—West 23d Street.
Erie R. R.—West 23d Street.
D., L. & W. R. R.—West 23d Street.
14th St., Hoboken—West 23d Street.
West Shore R. R.—Cortlandt St.

Four Ferry Group.

The third group, referred to as the "Four Ferries," handles 24 per cent of the present vehicular traffic and is located at such a distance uptown that it is doubtful if they will be greatly affected by the opening of the tunnel. They are as follows:

West Shore R. R.—West 42d Street.
West Shore R. R.—West New York.
130th Street—P. S. Ry. Co.
Dyckman Street.

Bridge Swings.

5. Records of bridge swings on the Hackensack and Passaic River Bridges were obtained from the County Engineer of Essex.

The results of these traffic counts are shown on the following tabulations:

1. *Highways Entering Jersey City.*

24-hour count.

LINCOLN HIGHWAY

Class of Vehicles	*1920*	*1921*	*1922*	*1923*
Motor trucks,	3,439	2,141	3,220	2,400
Pleasure cars,	6,747	4,455	9,984	14,100
Horse drawn,	397	327	304	430
All vehicles,	10,583	6,923	13,510	16,930

	Fairview	*Palisade Ave.*	*Anderson Ave.*
Class of Vehicles	*1923*	*1923*	*1923*
Motor trucks,	1,130	449	1,414
Pleasure cars,	7,069	4,792	4,355
Horse drawn,	58	41	100
All vehicles,	8,257	5,292	5,869

Class of	*Newark Turnpike*			*Paterson Plank Road*		
Vehicles	*1920*	*1922*	*1923*	*1920*	*1922*	*1923*
Motor trucks,	584	2,143	652	609	1,528	548
Pleasure cars,	1,134	3,310	9,929	1,040	2,876	6,430
Horse drawn,	72	190	30	140	102	30
All vehicles,	1,787	5,643	10,611	1,789	4,506	7,008

SUMMARY OF TRAFFIC COUNTS FOR 1923 ON MAIN ROADS OUT OF JERSEY CITY.

	Yearly	*Daily*	*Max. Hour*
Lincoln Highway,	5,756,200	16,930	1,387.7
Anderson Avenue,	1,995,460	5,869	464.6
Palisade Avenue,	1,799,280	5,292	434.5
Fairview,	2,807,380	8,257	676.8
Paterson Pl. Rd.,	2,382,720	7,008	574.4
Newark Turnpike,	3,607,740	10,611	861.5
Totals,	18,348,780	53,967	4,399.5

(*Note.*—Figures taken on Newark Turnpike cover the period of abnormal traffic in 1922 due to Hackensack River Bridge on Lincoln Highway being out of commission, and are excessive; those for Lincoln Highway being correspondingly low.)

Lincoln Highway Travel.

The above counts show a present Lincoln Highway daily traffic of 16,930 vehicles and a total daily traffic for all highways leading into Jersey City of 53,967.

The New Jersey Interstate Bridge and Tunnel Commission, in traffic studies over a period of years, developed the factor of 12.2 as representing the relation between daily and maximum hourly traffic, and if used in connection with the above figures results in a maximum hourly traffic on the Lincoln Highway of 1,387 vehicles, and a maximum total hourly traffic on all highways entering Jersey City of 4,400.

2. Newark City Streets.

10-hour count—8 A. M. to 6 P. M.

Street and Observation Pt.	*Year* 1912	1922	*Percentage of Traffic Increase*
Plank Road— Blanchard St. and Penn. R. R., ...	1,090	1,785	64
Market Street— Commerce St. and Ferry St., ...	1,179	2,857	142
Market Street— Beaver and Broad Sts., ...	4,232	8,315	97
Elizabeth Avenue— Grumman and Keer Aves., ...	964	4,281	344
Elizabeth Avenue— Miller and Wright Sts., ...	1,430	7,140	399
Clinton Avenue— 19th and 20th Sts., ...	1,593	4,537	185
Clinton Avenue— Milford and Elizabeth Aves., ...	2,495	7,300	193
Clinton Avenue— Broad and Halsey Sts., ...	2,390	10,134	338
Broad Street— Astor and Murray Sts., ...	643	8,250	1,183
Broad Street— Market and Mechanic Sts., ...	5,149	18,899	267
Jackson Street Bridge— Newark and Harrison Sts., ...	772	4,277	454
Bridge Street Bridge— Newark and Harrison Sts., ...	2,937	8,204	179
Frelinghuysen Avenue— Noble and Meeker Ave., ...	753	6,133	715
Frelinghuysen Avenue— Vanderpool and Pioneer Sts., ...	1,057	3,263	209
Frelinghuysen Avenue— Virginia Ave. and McClleland St., ...	.....	5,777	...

3. Bergen County Traffic Counts.

16-hour day counts.

	1921 Daily Average.
Paterson Plank Road, Borough of Carlstadt,	8,989
Bergen Turnpike, Borough of Ridgefield,	927
Anderson Avenue, Borough of Cliffside Park,	8,108
Bergen Turnpike, Fairview,	551

Note: In making comparison of these counts with other traffic counts in this report it must be noted that these are for 16-hour days, other counts being for 24-hour days. Also, these counts are for pneumatic-tired vehicles only.

This traffic has very much increased as will be seen by reference to tabulation on page 13, which shows for Paterson Plank Road, Fairview and Anderson Avenue, all of which lead to Bergen County road system.

USE OF NEW JERSEY HIGHWAYS BY FOREIGN TRAFFIC.

Foreign Cars.

As a matter of interest, from the traffic counts used in formulating this report, we are able to furnish the following figures as representing the percentage of foreign traffic using New Jersey highways.

The average of 14 traffic stations, extending to all parts of the State and including the summer period, shows that the percentage of foreign cars is 20.8 per cent.

The Station at Absecon, on Labor Day, based on a 24-hour count of 11,572 vehicles, showed a percentage of foreign cars of approximately 50 per cent.

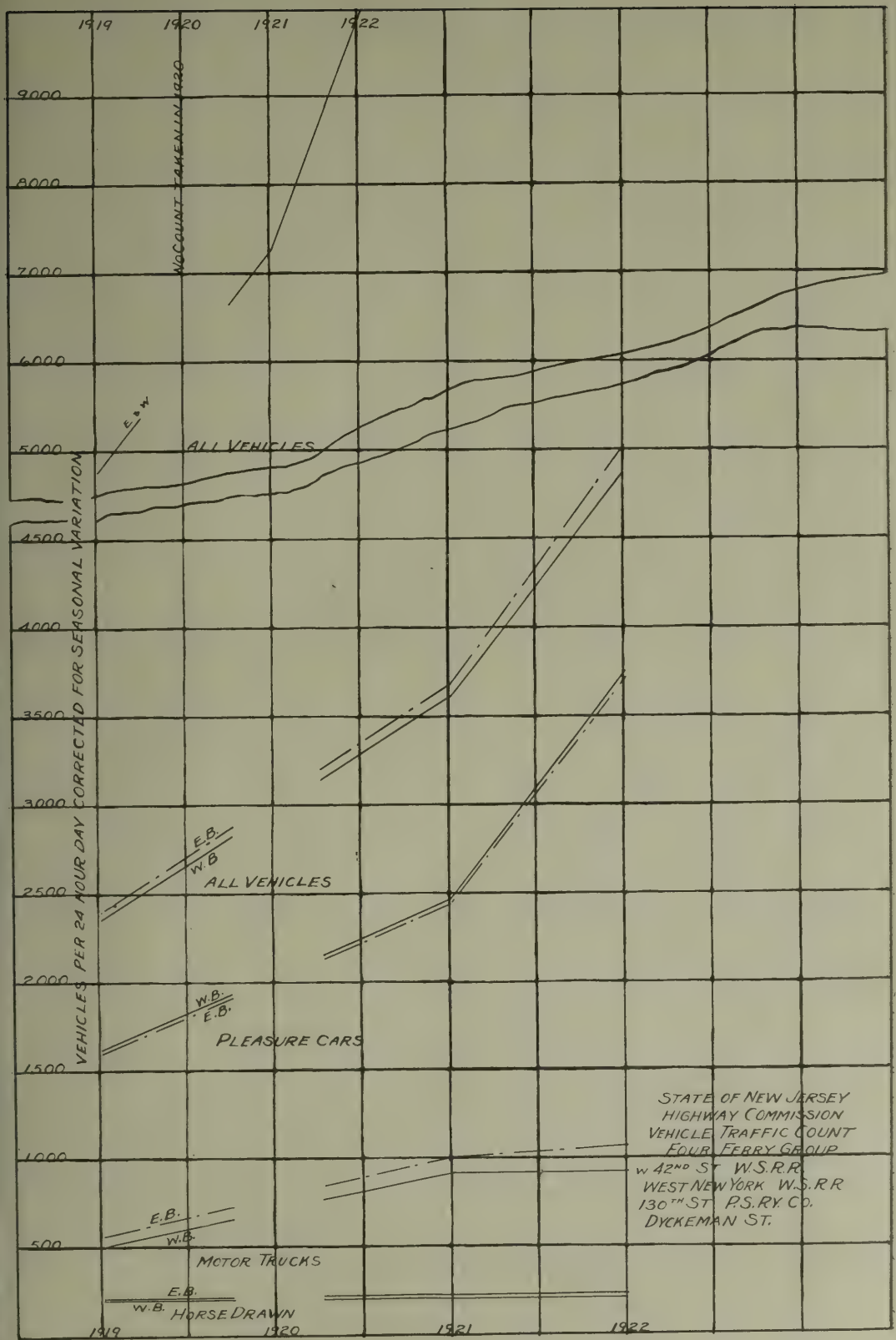
The main through Bergen County highways show an average of about 30 per cent foreign cars, while counts on the Lincoln Highway would seem to indicate an average percentage of 18.5 per cent.

4. Ferry Traffic.

Average day counts supplied by New Jersey Interstate Bridge and Tunnel Commission, of all figures adjusted for seasonal variations of traffic.

"Five Ferries" Group.			
Class of Vehicle.	*1919.*	*1921.*	*1922.*
Motor trucks,	3,358	4,784	4,349
Pleasure cars,	2,032	2,076	2,916
Horse drawn,	5,277	4,467	4,320
All vehicles,	10,667	11,327	11,585
"Six Ferries" Group.			
Motor trucks,	2,289	3,113	3,100
Pleasure Cars,	1,327	1,719	1,835
Horse drawn,	3 390	2,909	2,347
All vehicles,	7,006	7,741	7,282
"Four Ferries" Group.			
Motor trucks,	1,092	1,936	2,005
Pleasure cars,	3,274	4,940	7,515
Horse drawn,	429	438	431
All vehicles,	4,795	7,314	9,946
Note: No record made of West New York Ferry in 1922.			
Totals All Ferries—Average Day.			
Motor trucks,	6,739	9,833	9,454
Pleasure cars,	6.633	8.735	12.266
Horse drawn,	9,096	7,814	7,098
All vehicles,	22,468	26,382	28,818
Maximum Hourly Count All Ferries (12.2 Factor Used).	1,841	2,162	2,362
Yearly Averages All Ferries (340 x Average Daily).	*1919.*	*1921.*	*1922.*
	7,639,120	8,969,680	9,798,120

Pages Nos. 17 to 20 show curves of ferry increase and decrease.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STATE OF NEW JERSEY
HIGHWAY COMMISSION
VEHICLE TRAFFIC COUNT
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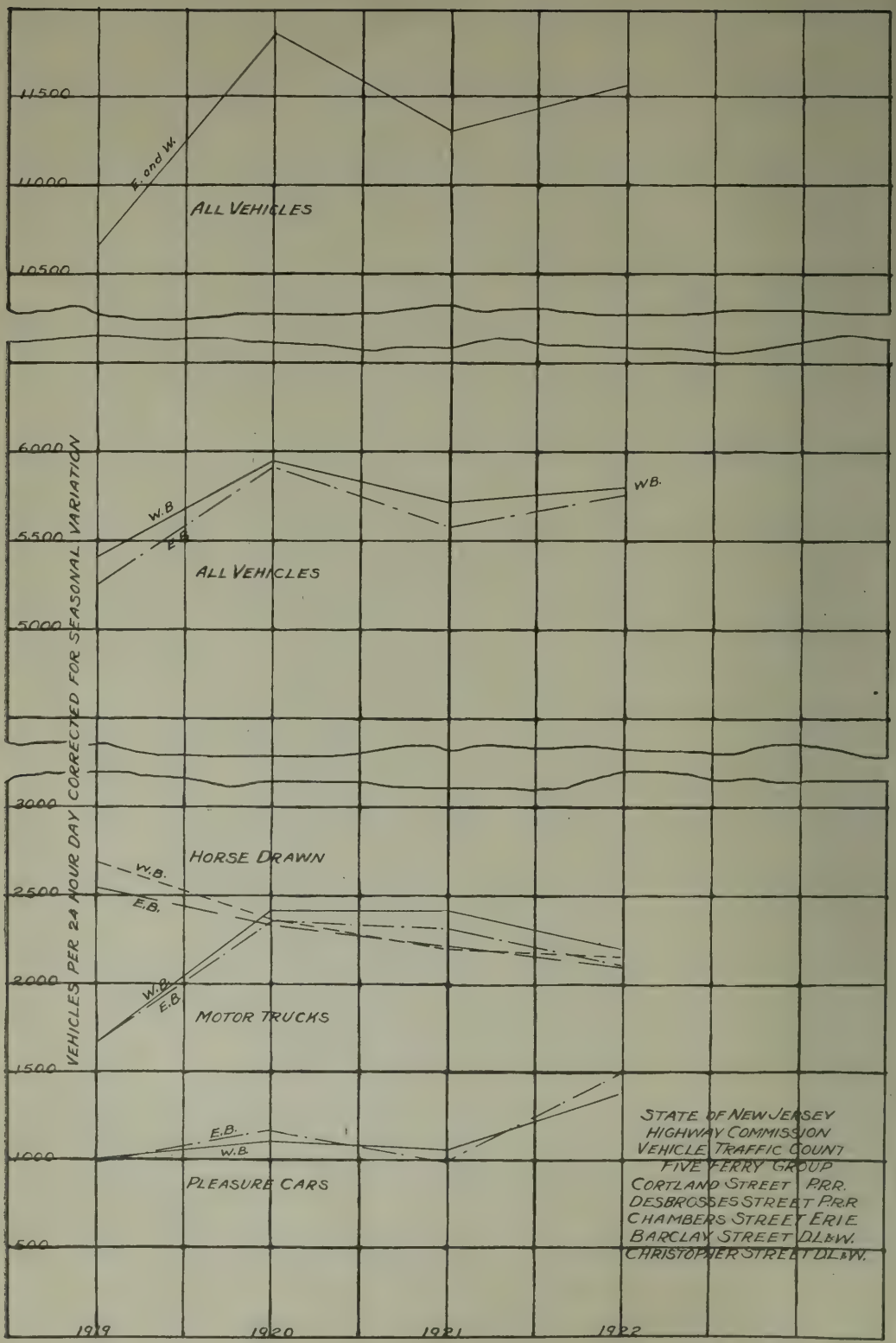
130TH ST P.S.RY. CO.
DYCKEMAN ST.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FIVE FERRY GROUP
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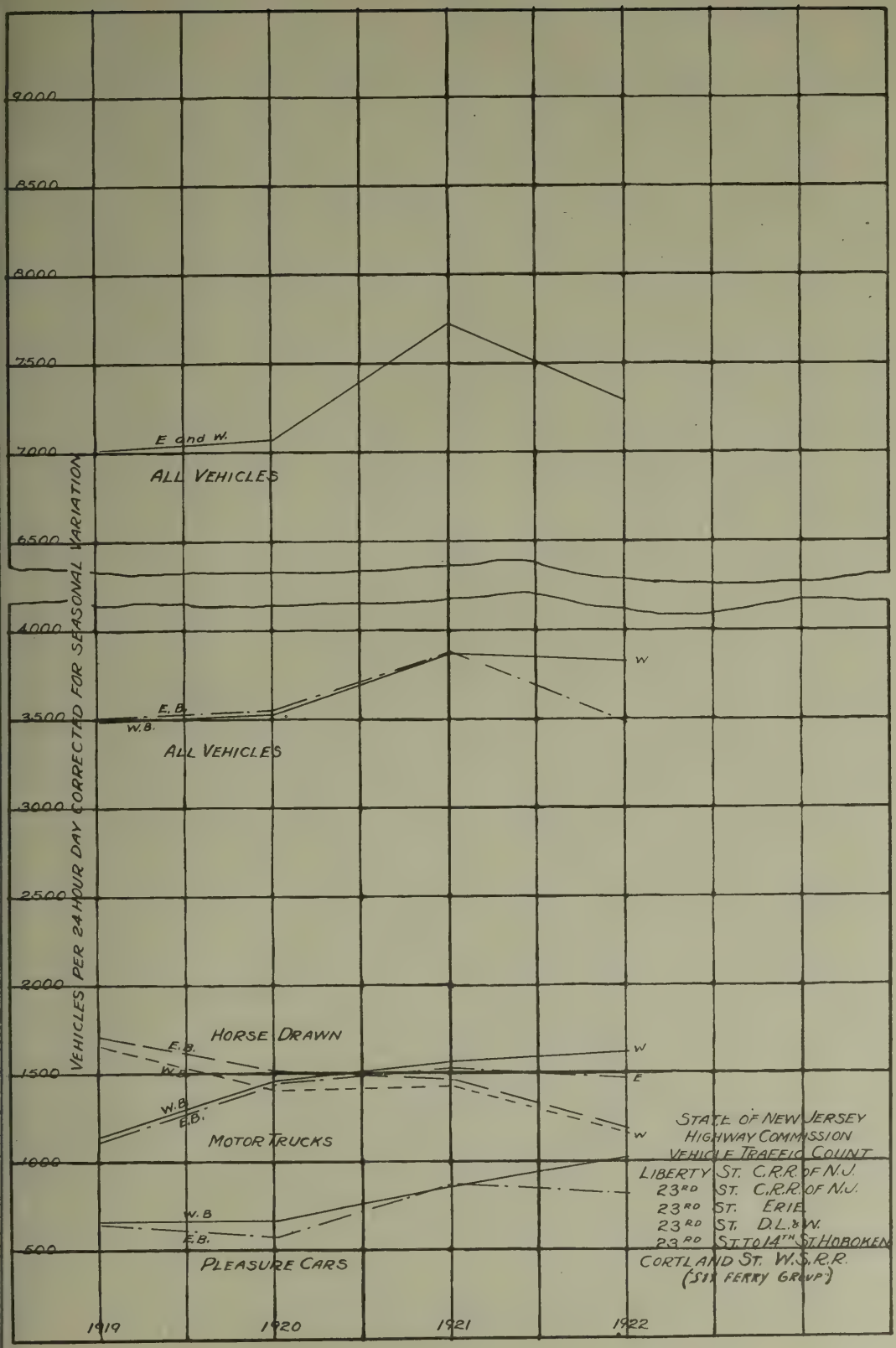
CHAMBERS STREET ERIE
BARCLAY STREET D.L.&W.
CHRISTOPHER STREET D.L.&W.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VEHICLES PER 24 HOUR DAY CORRECTED FOR SEASONAL VARIATION
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PLEASURE CARS
STATE OF NEW JERSEY
HIGHWAY COMMISSION
VEHICLE TRAFFIC COUNT
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23RD ST. C.R.R. OF N.J.
23RD ST. ERIE
23RD ST. D.L.&W.
23RD ST. TO 14TH ST. HOBOKEN
CORTLAND ST. W.S.R.R.
(SIX FERRY GROUP)
1919
1920
1921
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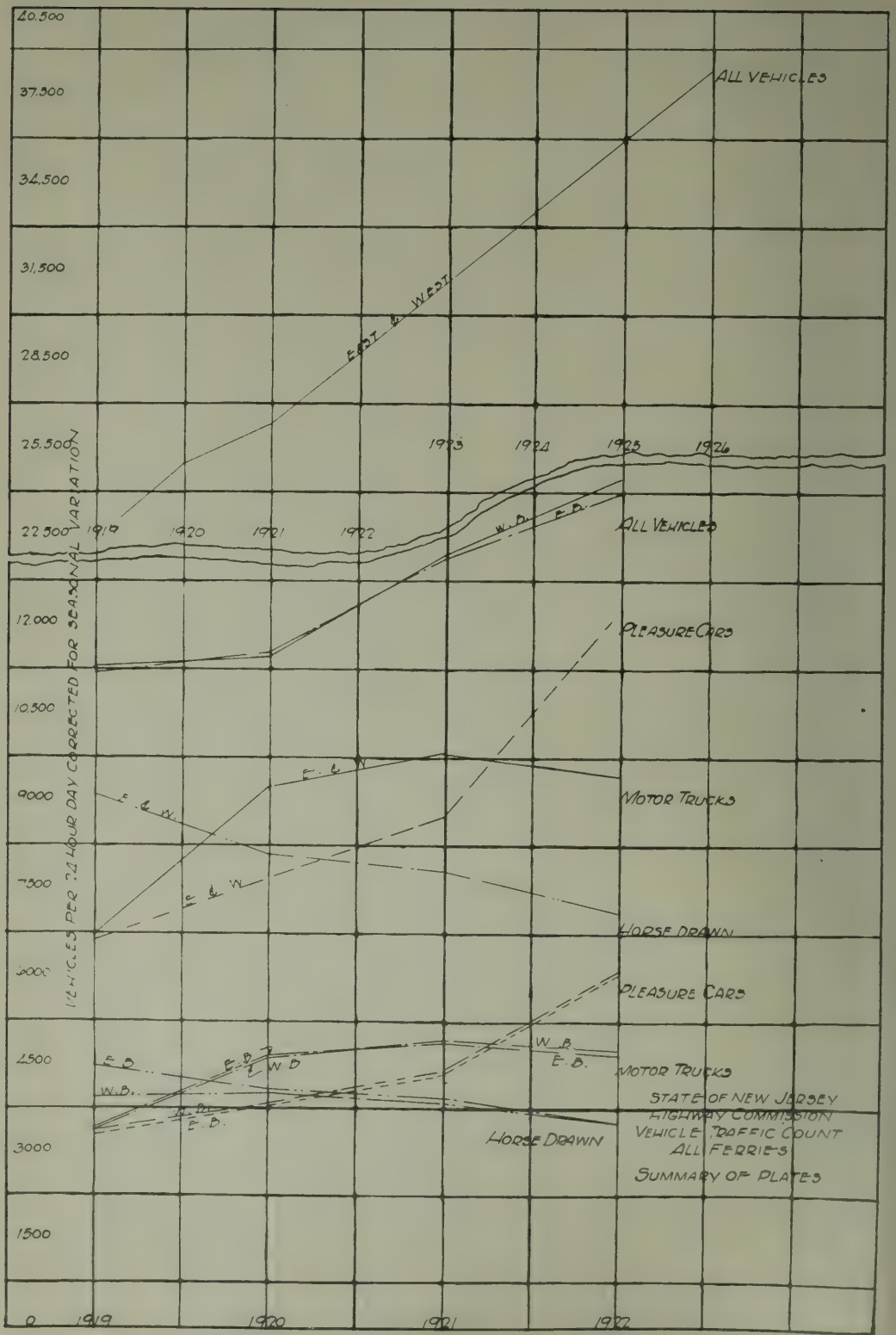
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PLEASURE CARS
MOTOR TRUCKS
E. & W.
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PLEASURE CARS
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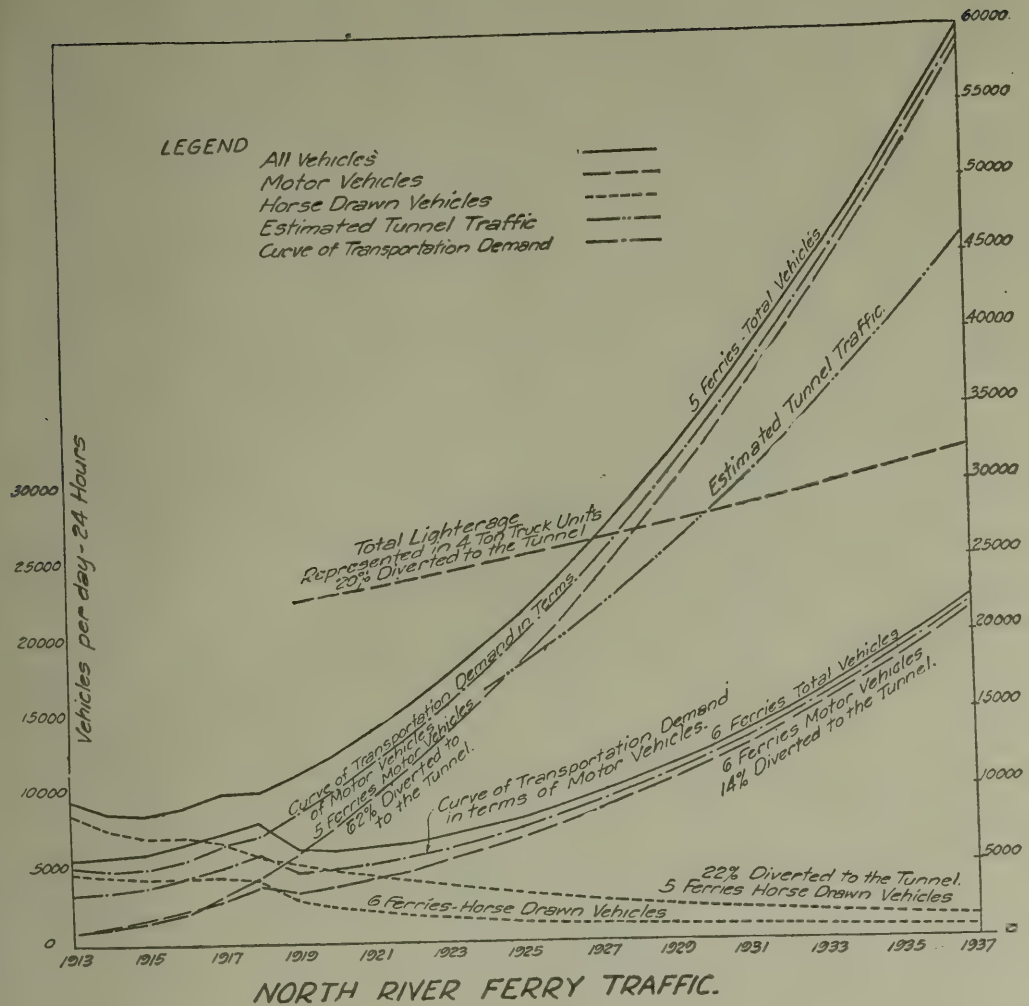
HORSE DRAWN
VEHICLES PER 24 HOUR DAY CORRECTED FOR SEASONAL VARIATION
STATE OF NEW JERSEY
HIGHWAY COMMISSION
VEHICLE TRAFFIC COUNT
ALL FERRIES
SUMMARY OF PLATES



NORTH RIVER FERRY TRAFFIC.

FERRY TRAFFIC DISTRIBUTION.

	Six Ferry Group.	*Five Ferry Group.*	*Four Ferry Group.*	*% Average.*
Hudson, ...	73%	74%	29%	59%
Passaic-Bergen, ...	6%	3%	52%	20%
Essex-Union, ...	21%	23%	19%	21%
	100%	100%	100%	100%

HACKENSACK AND PASSAIC BRIDGE TRAFFIC.

The situation created by the two drawbridges over the Hackensack and Passaic Rivers, respectively, is one which has received the careful consideration of the Board. The opening of these bridges to accommodate the requirements of navigation creates a serious delay to the traffic over the highway. From records which have been kept by the counties of Essex and Hudson there is shown that, due to the opening of the bridges, traffic was blocked for an average of 10.4% of the time. The detailed records are shown in the following tabulations. There is also shown a tabulation on page 24 covering a period of six months, which shows the number of openings and the character of craft on account of which the openings were made. Page No. 25 illustrates the height of vessels on both rivers.

5. Bridge Swings Showing Time Lost to Vehicles on Passaic River Bridge—Lincoln Highway—1923.

Swings Hour by Hour for One Year for Passaic River Bridge.		*Vehicles Crossing Bridge Daily.*	*Total Time (Min.) Lost by All Vehicles Daily.*
A. M. 12– 1	70	758	6.6
1– 2	70	277	2.4
2– 3	61	163	1.0
3– 4	64	122	.9
4– 5	64	98	.7
5– 6	75	93	.9
6– 7	151	91	3.6
7– 8	339	182	37.1
8– 9	484	417	174.1
9–10	624	425	294.9
10–11	578	682	404.9
11–12	502	743	333.8
P. M. 12– 1	450	657	237.0
1– 2	506	543	247.8
2– 3	480	959	393.8
3– 4	456	1,123	416.2
4– 5	417	1,022	316.7
5– 6	415	993	304 8
6– 7	265	1,204	150.7
7– 8	182	1,297	76.5
8– 9	139	1,137	39.1
9–10	153	1,106	46.2
10–11	96	1,606	26.3
11–12	76	1,232	12.6
Totals, ...	6,717	16,930	3,528.6

Economists figure the value of the time of a motor vehicle at 5 cents a minute and upward. On this basis the following computation would seem to be justified:

3,529 minutes lost by halted vehicles per day (58.8 hours).
For 365 days time lost would be 1,288,085 minutes, or 21,468 hours.
At 5 cents per minute time lost amounts to $64,404.25.
Capitalizing this loss, at 5 per cent per year, gives a possible investment of $1,288,085.00.

Bridge Swings Showing Time Lost to Vehicles, Hackensack River Bridge—Lincoln Highway—1923.

Swings Hour by Hour for One Year for Hackensack River Bridge.		*Vehicles Crossing Bridge Daily.*	*Total Time (Min.) Lost by All Vehicles Daily.*
A. M. 12– 1	9	758	.1
1– 2	11	277	.05
2– 3	7	163	.001
3– 4	4	122	.0003
4– 5	11	98	.002
5– 6	25	93	.009
6– 7	66	91	.1
7– 8	146	182	6.3
8– 9	263	417	46.8
9–10	368	425	93.2
10–11	382	682	161.0
11–12	349	743	146.6
P. M. 12– 1	344	657	125.9
1– 2	342	543	102.8
2– 3	326	959	165.1
3– 4	278	1,123	140.5
4– 5	251	1,022	104.3
5– 6	192	993	59.2
6– 7	98	1,204	18.7
7– 8	42	1,297	3.7
8– 9	34	1,137	2.1
9–10	15	1,106	.04
10–11	9	1,606	.02
11–12	7	1,232	.01
Totals, ...	3,579	16,930	1,176.5323

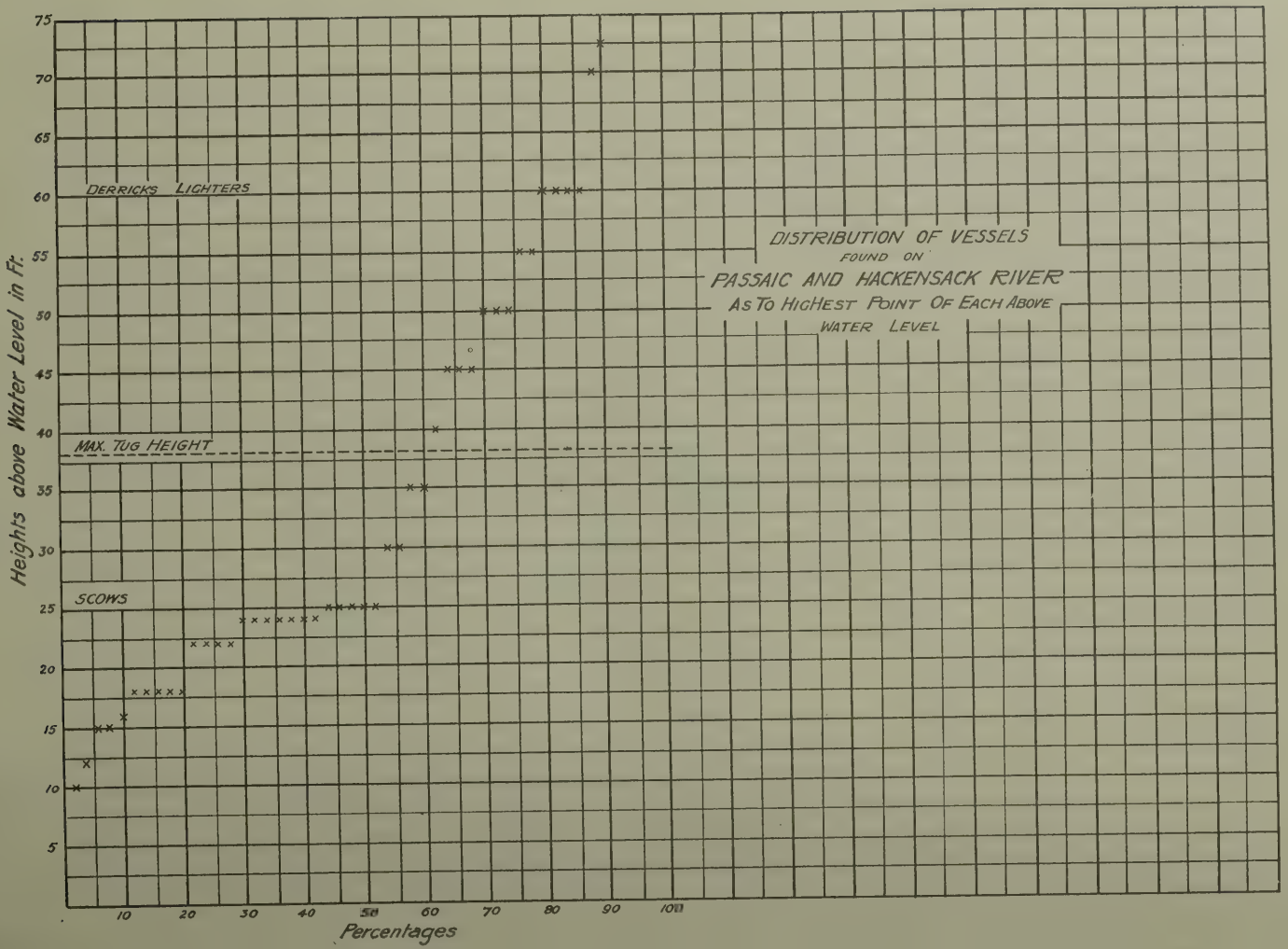
1177 minutes lost by halted vehicles per day (19.6 hours.)
429,605 minutes lost in one year (7,160 hours).
$21,480.00 capitalized money value of time lost in one year at 5 cents per minute.
$429,605.00 capitalized possible investment.

Passaic River Bridge—1923.

	Lighters, Schooners, Tankers and Steamers.	*Total Swings.*	*Per Cent of Lighters, etc., to Total Swings.*
January,	197	539	36.5
February,	154	396	38.8
March,	194	523	37.0
April,	170	602	28.2
May,	214	633	33.8
June,	257	681	37.0
Totals,	1,407	3,374	35.3

Hackensack River Bridge—1923.

	Lighters, Schooners, Tankers and Steamers.	*Total Swings.*	*Per Cent of Lighters, etc. to Total Swings.*
January,	294	388	75.8
February,	146	196	74.4
March,	298	383	77.8
April,	385	464	82.9
May,	384	453	84.7
June,	309	446	69.2
Totals,	1,816	2,330	77.4


DISTRIBUTION OF VESSELS
FOUND ON
PASSAIC AND HACKENSACK RIVER
AS TO HIGHEST POINT OF EACH ABOVE
WATER LEVEL
DERRICKS LIGHTERS
MAX. TUG HEIGHT
SCOWS
Heights above Water Level in Ft.
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
10
20
30
40
50
60
70
80
90
100
Percentages

PROBABLE FUTURE TRAFFIC.

Licenses by States.

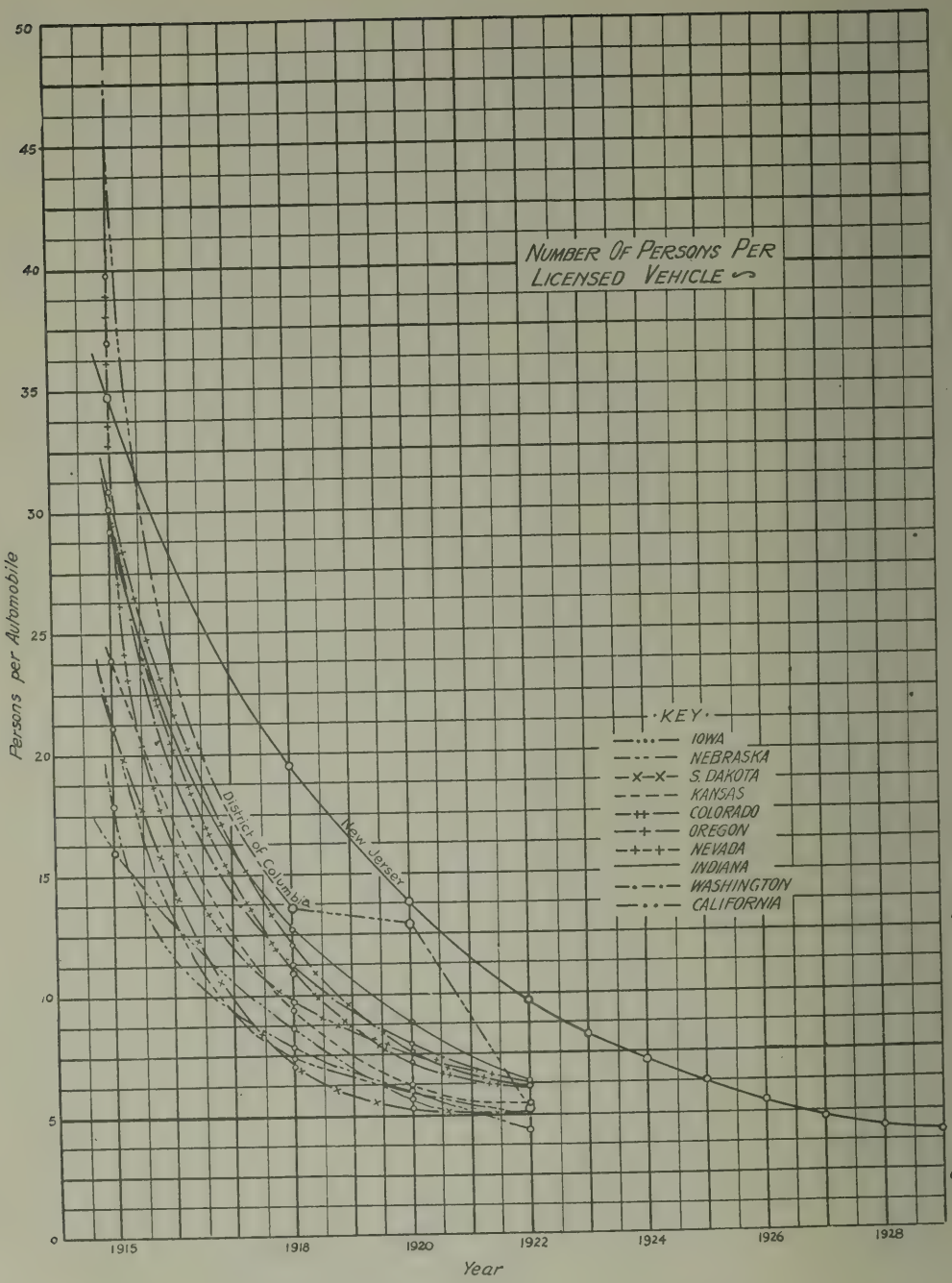
The growth of highway travel has of late depended primarily upon growth in the use of the automobile for pleasure and business purposes. There is reason to believe that future growth will follow the same tendencies. The tabulation on Page 27 shows the number of motor vehicle licenses issued from 1914 to 1922, inclusive, in twelve States, those being selected which, in 1922, had the greatest number of motor vehicles licensed per capita. In the same tabulation are included figures which show the number of persons per licensed vehicles in each of four years. The diagram on Page 28 visualizes the tabulated figures. Examinations of the tabulation and the diagram indicate that the States selected, at least, are fast approaching a saturation point in automobile ownership. This saturation figure may be assumed for the present at four persons per licensed vehicle. In 1922 the ratio of motor vehicles to population gave New Jersey 9.2 persons per motor vehicle. In the diagram, the New Jersey line has been projected into the future along a curve which seems logical in the light of past experience.

NEW JERSEY STATE HIGHWAY COMMISSION.

REGISTRATION OF PASSENGER AND COMMERCIAL MOTOR VEHICLES FOR STATES OF MAXIMUM CARS PER CAPITA.

STATE.	1914.	1915.	*	1916.	1917.	1918.	*	1919.	1920.	*	1921.	1922.	*
California, ...	123,504	163,797	17.74	232,440	306,916	407,761	7.89	477,450x	568,892	6.04	663,251	861,807	4.29
Iowa, ...	106,087	145,109	15.92	198,587	254,462	278,313	8.52	363,079	437,378	5.51	461,084	500,158	4.90
Nebraska, ...	16,385	59,000	21.10	101,200	148,101	173,374	7.36	200,000	219,000	5.92	238,704	256,654	4.97
Dist. of Columbia, ..	4,853	8,009	48.00	13,118	15,493	30,490	13.64	35,400c	34,161	12.81	40,625d	52,792	5.12a
South Dakota, ...	20,929	28,724	21.21	44,271	67,158	90,521	6.92	104,628	120,395	5.28	119,274	125,241	5.19
Kansas, ...	49,374	72,520	23.90	112,122	159,343	189,163	9.28	227,752	294,159	6.02	289,539	327,194	5.47
Colorado, ...	17,756	28,894	30.08	43,296	87,460	83,244	10.94	104,865	129,255	7.27	145,739	162,328	6.01
Oregon, ...	16,147	23,585	30.80	33,917	48,632	63,324	12.02	83,332	103,890	7.56	118,095	134,125	6.05
Nevada, ...	1,487	2,009	39.70	4,919	7,160	8,159	9.60	9,305	10,464	7.41	10,821	12,116	6.12
Indiana, ...	66,500	96,915	29.10	139,065	192,194	227,160	12.72	227,255	333,067	8.82	400,342	469,939	6.36
Washington, ...	30,253	38,823	32.19	60,734	91,337	117,278	11.19	148,775	173,920	7.81	185,359	210,716	6.39
New Jersey, ...	62,961	81,848	34.78	109,414	141,918	155,519	19.47	190,873	227,737	13.87	272,994	342,286	9.71

* Persons Per Vehicle.
(x) Does Not Include 10,000 Cars Operated Under Exempt Licenses.
(c) Does Not Include Non-Resident Registration.
(d) Does Not Include 8,439 Non-Resident Passenger Cars and 1,023 Non-Resident Trucks.
(a) Does Not Include 19,926 Non-Resident Cars or 1,836 Non-Resident Trucks.


NUMBER OF PERSONS PER LICENSED VEHICLE
KEY
IOWA
NEBRASKA
S. DAKOTA
KANSAS
COLORADO
OREGON
NEVADA
INDIANA
WASHINGTON
CALIFORNIA
District of Columbia
New Jersey
Persons per Automobile
Year
50
45
40
35
30
25
20
15
10
5
0
1915
1918
1920
1922
1924
1926
1928

Future Licenses.

These studies lead to the conclusion that the number of licenses which will probably be issued in future years will depend upon the growth in population and within the next decade will reach a saturation point at about one vehicle for each four persons. In order to determine, therefore, the number of vehicles which will probably be licensed, the future population must be estimated. Studies of past growth down to the present time, of countries, States and cities, show conclusively that a general law is universally followed which results in the following general characteristics:

> Growth is at first slow, but at an accelerated rate, the acceleration itself first increasing and then decreasing so as to become negative. Thus the rate of growth eventually slows down, even though the actual increment, year by year, may be large, until finally a condition is reached when the increments themselves agree less and less until a state of approximate stability or saturation is reached, when population statistics reveal themselves in a population curve with a general "S" shape.

Population Growth.

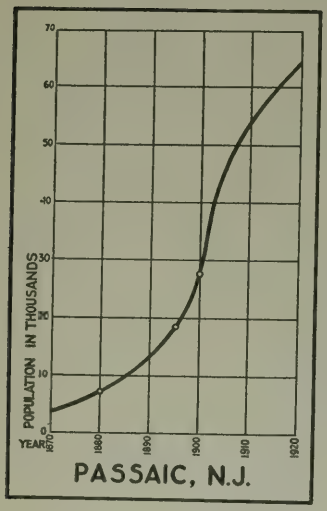
The diagrams on pages 30 and 31 illustrate these statements. The curve for the City of Passaic on page No. 30 is typical. Examination of the curves for the United States and the State of New Jersey indicate that in each case the maximum rate of growth has been reached, and while the country, as a whole, and the State itself will increase in population, the rate of this increase for each decade will be at a falling rate. An estimate on this basis for the State of New Jersey for the next three decades would be as follows:

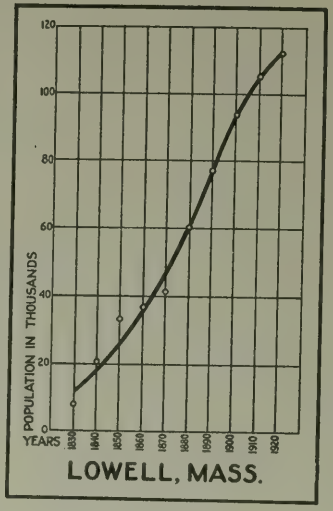
Population in 1930,	3,750,000
Population in 1940,	4,260,000
Population in 1950,	4,700,000

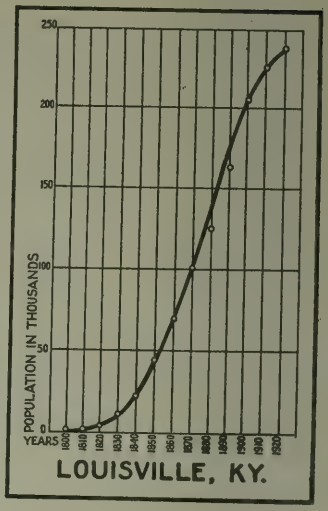
4 835 000

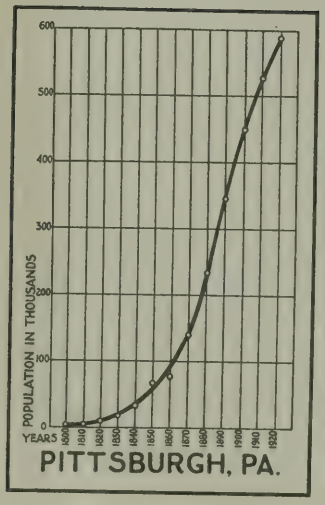
In other words, it is estimated that by 1950 the population of the State will have increased not quite 50 per cent over that of the year 1920. Applying the factor of

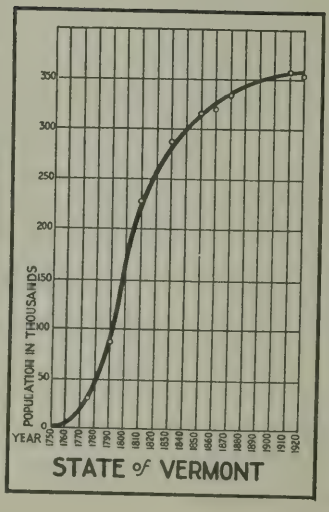
POPULATION CURVES

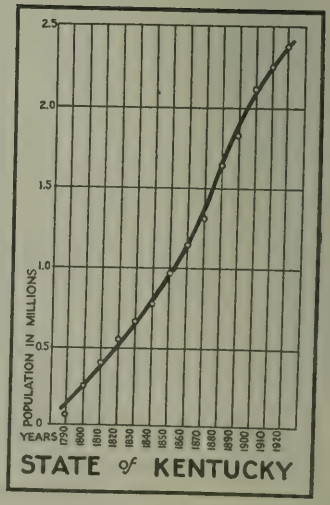


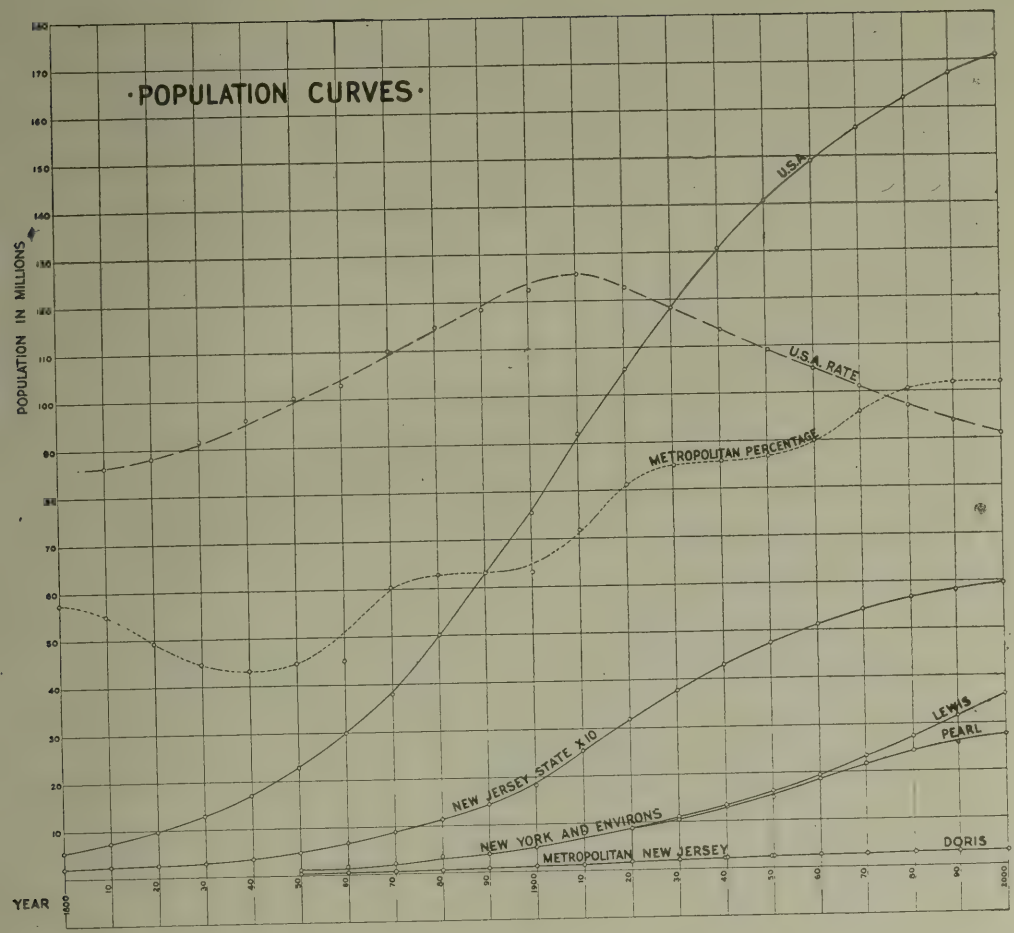











·POPULATION CURVES·
POPULATION IN MILLIONS
YEAR
U.S.A.
U.S.A. RATE
METROPOLITAN PERCENTAGE
NEW JERSEY STATE X10
NEW YORK AND ENVIRONS
METROPOLITAN NEW JERSEY
LEWIS
PEARL
DORIS

four persons per licensed vehicle to the 1950 population, gives an estimated number of licenses for that year aggregating 1,175,000. Based on the number of licenses issued up to July 1, 1923, compared with the number which had been issued up to the same date last year, it is estimated that the total for the year 1923 will be about 438,000 exclusive of motorcycles and manufacturers' and dealers' cars. By 1950, then, it is to be expected that the number of licensed vehicles will be 2.7 times that of the present year.

Horse-Drawn Vehicles.

It cannot be assumed that, necessarily highway traffic will increase in direct proportion to the number of licensed motor vehicles. In this connection the factor introduced by the existence of horse-drawn vehicles must be considered. As long ago as 1912 it was found that the percentage of horse-drawn vehicles on Massachusetts State highways was 37% compared with 61% for the year 1909. In the City of New York the total number of horses for which the Health Department issued licenses has remained practically stationary for a considerable period. In New York City horse-drawn vehicles in 1917 were 34½% of the total street traffic. In the State of New Jersey the total number of horses on farms as reported by the 1920 census, as of January first, was 72,621, whereas on April 15th, 1910 the number was 88,239. Assuming that horse-drawn vehicles in 1917 constituted one third of the total and that there has been no falling off, the large increase in motor vehicles means that horses now constitute only 20% of the total traffic.

If motor travel doubles while horse-drawn traffic remains constant the percentage of horse-drawn travel falls to 11.1%. It may therefore be ignored without material error.

Comparisons.

A tabulation on page No. 34 shows the number of automobile licenses issued in various States in comparison with the traffic on streets and highways indicated.

An accompanying diagram on page No. 35 visualizes these statistics. They have been plotted on logarithmic paper so that the rate of increases can be directly measured. The several lines are seen to be fairly parallel, those for New Jersey points being quite consistent. Measured by the slope of the lines in diagram, it is found that traffic has increased in New Jersey as the square root of the increase in the number of licenses. Considering all the points examined, it is seen that the variation runs from the one-half to the one power.

Traffic Assumption.

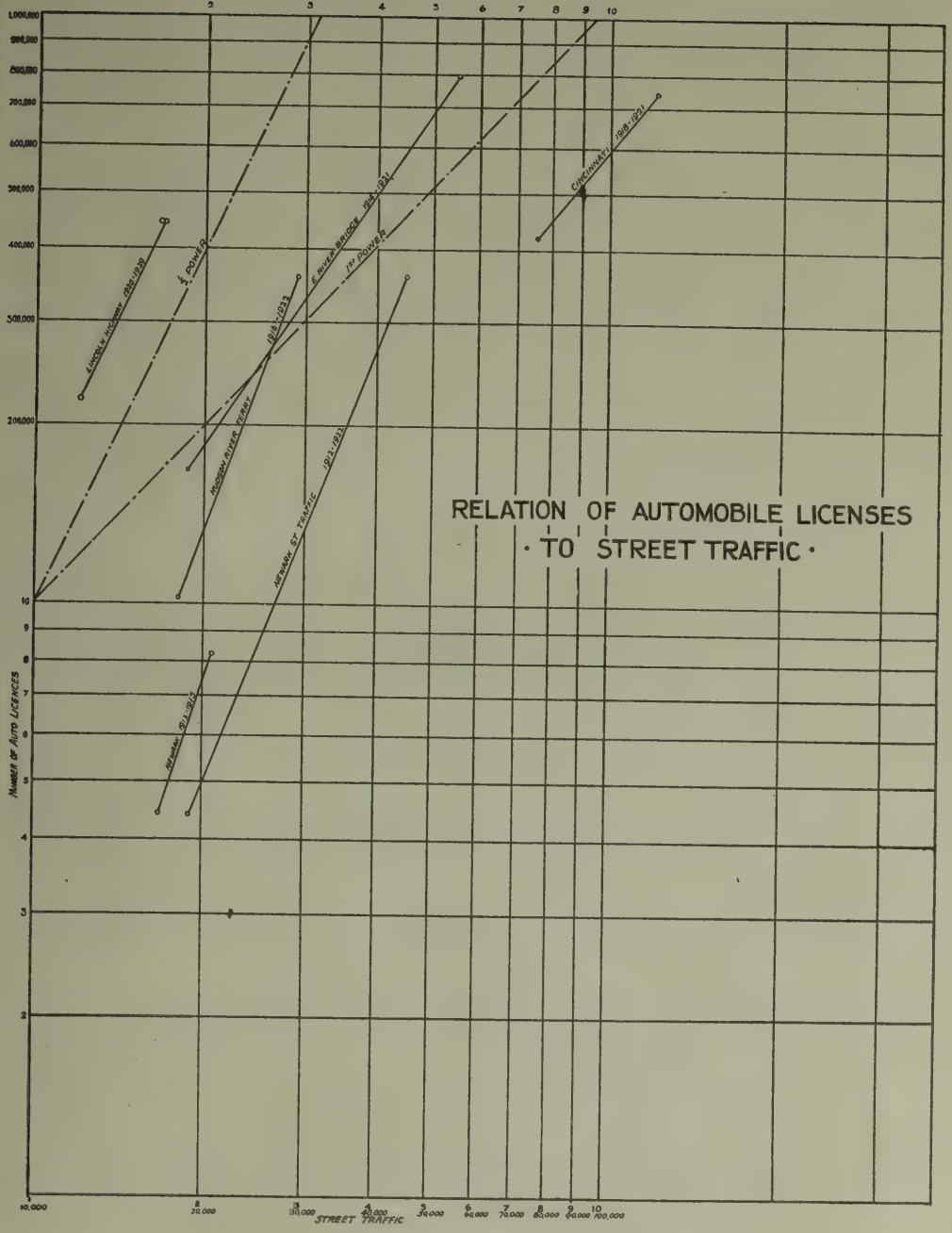
Assuming that licenses will increase 2.7 times, while street traffic will increase as its square root, it is seen that the highway travel will increase slightly more than one and one-half times. If the extreme assumption is made that the traffic will increase as the first power of the number of licenses the highway travel will increase 2.7 times.

Experience in the State of New Jersey as a whole does not indicate any such probable increase of 2.7 times. However, the situation which we have before us is not representative of the State of New Jersey as a whole, and it is believed that the extreme assumption, that traffic in this particular district will increase as the number of licenses, should be used.

In this connection, the relation of New Jersey to through traffic should also receive consideration. Its highways are the connecting links for a heavy through traffic between centers of congested population at either end, as for instance, New York City to Atlantic City,—New York City to Trenton, and to Philadelphia.

Relation Of Automobile Licenses To Street Traffic

Date	Auto Licenses	% Inc.	Street Traffic		% Inc.	Ratio of %
			Location	Number		
1920 1923	220'000 } Approx. 440'000 } (New Jersey)	100%	Lincoln H'way	12'000 17'000	41.6%	2.4
	(New Jersey)					
1912 1922	44'000 354'000	704%	Newark	19'000 45'000	136.8%	5.11
	(New Jersey)		Hudson River Ferry			
1916 1922	104'000 354'000	240.5		18'000 29'000	60.8%	39.5
	(New York)					
1914 1921	168'223 779'344	362.5%	E. River Bridge	18'790 55'184	193.6%	1.8
	(Ohio)					
1918 1921	413'000 721'000	74.5%	Cincinnati	76'000 122'000	60.5%	1.2
	(New Jersey)					
1912 1915	44'000 82'000	86.3	Newark	167'000 208'000	24.5	0.28


RELATION OF AUTOMOBILE LICENSES
· TO STREET TRAFFIC ·
NUMBER OF AUTO LICENCES
STREET TRAFFIC
LINCOLN HIGHWAY 1910-1928
½ POWER
E. RIVER BRIDGE 1914-1921
1st POWER
CINCINNATI 1918-1921
HUDSON RIVER FERRY 1913-1923
NEWARK ST. TRAFFIC 1913-1923
NEWARK 1913-1916

POINTS OF PROBABLE FUTURE CONGESTION.

Congested Points.

Two points at which future congestion will occur, and, as a matter of fact are now congested to the limit, are the main streets of the City of Newark, and the City of Elizabeth. In making recommendations, it is necessary to provide for new highways at each of these points which will carry traffic outside of the congested districts.

Congestion will, of course, also accur through the city of Jersey City, unless provision is made to take care of traffic increase.

TUNNEL TRAFFIC IN 1926 AND PROBABLE GROWTH.

Tunnel Traffic.

The Chief Engineer of the New Jersey Interstate Tunnel Commission estimates that traffic through the tunnel will more than double within eight years after the tunnel opens.

On pages Nos. 17 to 20 are shown graphically the vehicular traffic count on the three ferry groups previously mentioned, and on page No. 16 there is a chart showing the vehicular count on all ferries. Page No. 21 shows curves taken from the report of the New York and New Jersey Interstate Tunnel Commission, showing the traffic on the Five Ferries and the Six Ferries groups, and also the estimated tunnel traffic.

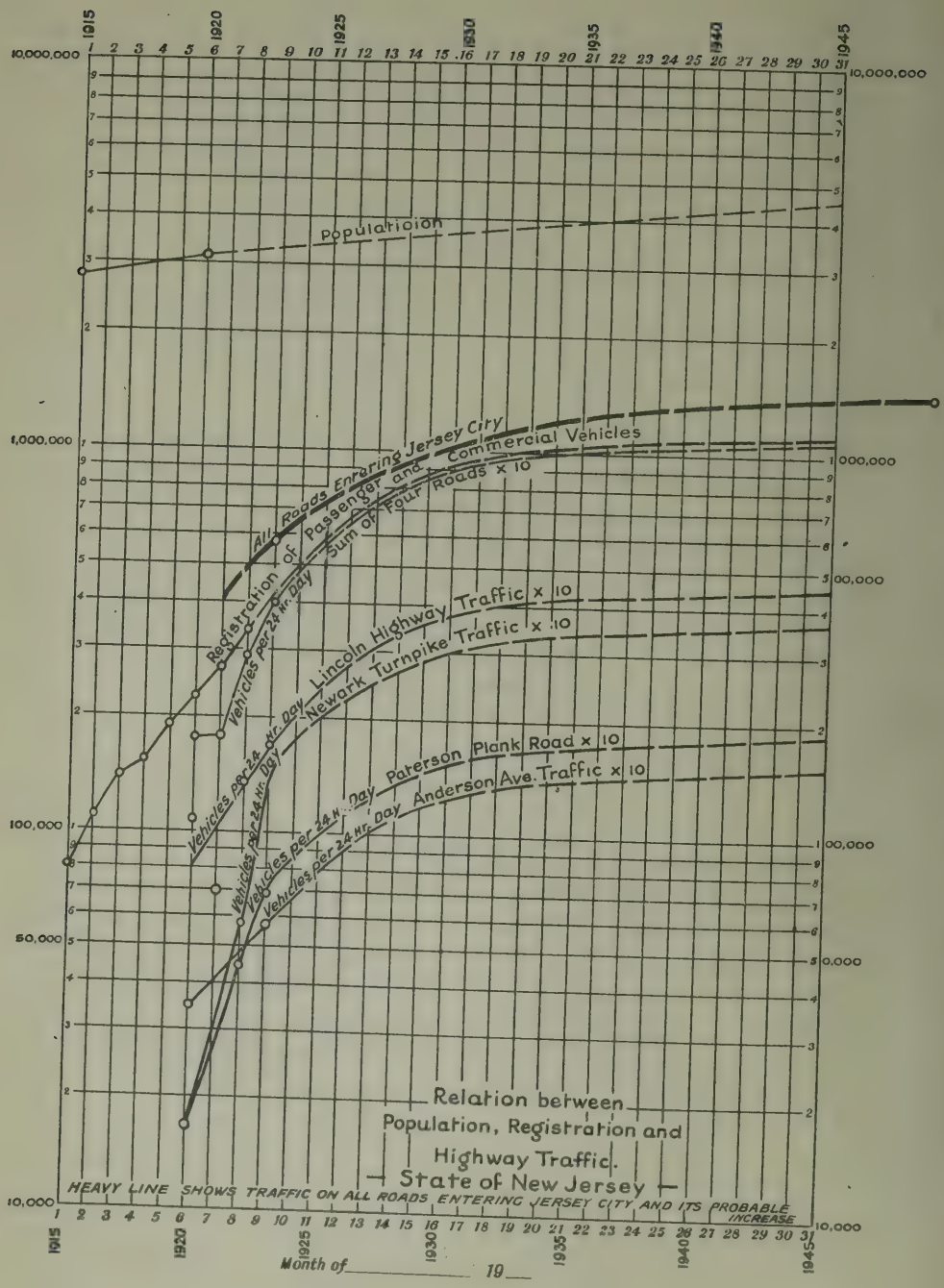
Traffic Totals.

From this chart, it is interesting to note the following figures. The total ferry traffic on the "Four Ferries" group for the year 1922 is 3,381,640; for the "Five Ferries" group it is 3,938,900; and for the "Six Ferries" group it is 2,475,880,—or approximately 10,000,000 vehicles per year for all ferries in 1922. Projecting the curve to include 1926, it shows a total ferry traffic of that year equal to 11,424,000, or 33,600 as a daily traffic and 2,754 as a maximum hourly traffic.

From the diagram on page No. 21 it is to be noted that the estimated tunnel traffic as of the year 1926 is 6,770,000, and that within eight years thereafter the tun-

nel traffic will more than have doubled, amounting to 15,640,000, which would mean an average daily traffic of 46,000 or at the maximum hourly rate of 3,770, which is approximately the estimated capacity of the tunnel. It is fair to assume that most of this travel will continue through Jersey City, or at least to the westerly limits of same, and that such part as does not continue will be at least made up for by traffic originating on the water front in Jersey City, and this figure can therefore reasonably be assumed to represent the traffic which, in 1937, when the tunnel will have reached its capacity, will be delivered to the viaduct and route through Jersey City. **Traffic in 1937.**

It is further to be expected that the ferries will continue to operate with at least their present volume of traffic, a considerable part of which will pass through Jersey City. Present maximum hourly ferry traffic is 2,362. It is fair to assume that 50% of this traffic will proceed through Jersey City by way of Route No. 1, which, added to the maximum hourly traffic which it is assumed will be received from the vehicular tunnel and Jersey City water front amounting to 3,770, makes a total of 4,951 which would appear to be the maximum traffic demand which would be placed on the highway leading out of Jersey City to Elizabeth, at the time the tunnels have reached their maximum carrying capacity. Again, if the present maximum hourly traffic entering Jersey City is 4,399, and the proposed highway will carry 50% of the total, which at present is the per cent carried by both the Lincoln Highway and the Newark Turnpike, and the extreme increase of 2.7 be assumed, then the resulting maximum hourly traffic for the new highway would be 5,937. A mean between the two estimates, say 5,444, maximum hourly traffic, would appear to be a safe estimate. **Traffic Estimates.**


Population
All Roads Entering Jersey City
Registration of Passenger and Commercial Vehicles
Sum of Four Roads x 10
Vehicles per 24 hr. Day
Lincoln Highway Traffic x 10
Newark Turnpike Traffic x 10
Vehicles per 24 hr. day
Paterson Plank Road x 10
Vehicles per 24 hr. Day
Anderson Ave. Traffic x 10
Vehicles per 24 Hr. Day
Relation between
Population, Registration and
Highway Traffic.
State of New Jersey
HEAVY LINE SHOWS TRAFFIC ON ALL ROADS ENTERING JERSEY CITY AND ITS PROBABLE INCREASE
Month of 19

ECONOMICS OF GRADE.

In the study of the economics of grades and rise and fall on highways used by motor vehicles, the Advisory Board was confronted with a problem on which very little work has yet been done. It is to be appreciated, however, that this is a very vital consideration, and effort has been made to embody in the recommendations such conditions as regard grades as would seem to be justified by the information at hand.

Grade Factors.

The factors to be considered in connection with grades and the economy of operation are (1) the delays incident to the slowing up of traffic due to the necessity for using low gears; (2) the additional consumption of gasoline, and (3) the extra wear and tear on the vehicle.

Viaduct Grade.

So far as the first consideration is concerned, the limiting condition as to grade on the highway which will be recommended herein is based on the viaduct, from the tunnel plaza to the high ground in Jersey City. The grade required to accomplish the elevation in the distance is 3.2.

Grades:

The only exception to this maximum is on Broadway, in Jersey City, where for a distance of approximately 750 feet, 4.6 and 5 per cent grades will be necessitated if the present street grade is used and the approaches to the tunnels under the Hackensack and Passaic Rivers where 4 per cent grades are used in making up the estimates. It is entirely feasible to build a short viaduct which would bring the grade on Broadway within the above-mentioned limit, if it is later determined to be necessary, but the line of the highway at this point being on a tangent, and for other considerations, it has not been deemed necessary to recommend this viaduct at this time. The tunnel approach grades could also be reduced if it were on further study considered desirable. It is questionable whether this grade of 3.2 per

Truck Grades.

cent will permit all loaded commercial trucks to negotiate it on high gear. Studies made by the Board on the Warren Street hill, in Trenton, where the grade is 3 per cent for 126 feet, and 5.7 per cent for 200 feet indicated that 29.5 per cent of the motor trucks were compelled to shift gears before reaching the top of the hill. In studies made on Montgomery Street hill, in Jersey City, the figures show that 43.8 per cent of the trucks shifted gears to negotiate the hill. The grades are 2.7 per cent for 700 feet and 4.4 per cent for another 700 feet. However, it must be borne in mind that both of these streets are in a congested district, with frequent cross streets, and under traffic regulations. It is believed that the conditions on the grades adopted will be considerably better than the showing made in Trenton and Jersey City, but it is still doubtful as to whether all trucks will be able to accomplish the grades using high gears. However, physical conditions determine these grades and they could not be reduced without an unwarranted expenditure of money.

Economics.

The effect of grade and total rise and fall on gasoline consumption, and wear and tear on vehicles is susceptible of analysis, and, on the basis of experiments of Professor T. R. Agg, of the Engineering Experiment Station, Ames, Iowa, we deduce the following for each ten feet in reduction of total rise or fall:

Per cent of grade,	5.1	3.7
Tons miles per gallon,	11.22	13.20
Tons miles on flat grade,	29.7	29.7
Gallons per ton mile on grade,	0.0892	0.0757
Gallons per ton mile flat,	0.0337	0.0337
Gallons per ton mile difference,	0.0555	0.0420
Rise feet per mile,	269.28	195.36
Gallons per ton mile to rise one foot,	0.000265	0.000215

Lincoln Highway travel, 1923, per 24-hour day,	16,930
Estimated Lincoln Highway travel when tunnel is at capacity,	66,368
Estimated cut in hill,	10 feet
Estimated average total weight of car and load,	3 tons
Estimated days per year,	300
Estimated cost of gasoline per gallon,	25c
Estimated factor for gasoline per ton mile to rise one foot,	0.000215

Computed annual saving on a basis of 66,368 cars per day—$32,105 per year. Assuming this amount to be capitalized at 5 per cent, indicates a maximum expenditure of not to exceed $642,100 to accomplish the gasoline saving for each 10-foot rise eliminated. The saving in wear and tear on vehicles would undoubtedly equal a like amount, or a total round figure of $1,250,000.00 for each ten feet of rise and fall eliminated.

CURVES.

Curves. Curves on highways are objectionable from the point of view of dangers incident to their presence, and also due to the fact that in rounding curves, particularly if sharp, there is a slowing up of traffic. From the information before us, we believe that a curve having a radius of not less than 150 feet can be accomplished by motor trucks without changing gears, and we have limited the curvature on the recommended route to curves having a radius not less than the above mentioned figure.

GRADE CROSSINGS.

Grade Crossings. The presence of grade crossings with either highways or railroads, likewise, presents conditions which tend to slow up traffic, as well as creating the element of danger. The recommendations for the route and construction, as submitted herewith, are prepared and based on the elimination of such crossings so far as possible. With the exception of Tonnelle Avenue, in Jersey City, this has been practically accomplished between the entrance to the tunnel and the Newark city line. The Tonnelle Avenue crossing can be later eliminated by the elevation of Tonnelle Avenue, if it seems advisable.

Economics. From our study of the situation, we believe the capitalized value of elimination of a grade crossing on this highway to be approximately $1,700,000.00.

WIDTH OF ROADWAY.

Width.

Numerous traffic observations on various streets and highways have established the maximum number which, under normal conditions of congestion, will pass a given point on roadways of different widths. For example, on roadways without car tracks and where no parking is permitted on either side, but where cross traffic will interrupt travel at distances from 400 to 800 feet apart, only 2,400 vehicles can normally use a roadway 40 feet wide. Without interruption from cross travel this number can be increased to well over 4,000. In a few cases as many as 5,000 have been observed. The Chief Engineer of the Bridge and Tunnel Commission estimates the maximum hourly capacity of two tubes, each designed for two lines of travel, to be 3,800 per hour. Higher speeds, with increased facility and increased traffic are provided for by additional roadway widenings, an additional speed amounting to as much as 25 per cent resulting from an increase in width from 10 to 12 feet for each traffic lane. With the estimate as shown above, the maximum of the traffic over the highway from Jersey City to Elizabeth will be close to this maximum figure, and it is felt that the roadway should be of sufficient width to provide for two moving lines of travel in each direction, and accommodation for disabled vehicles as well. Therefore, the Advisory Board has assumed that the width of highway should be 50 feet on all viaducts and subways, where parking along the side will not be required, and that it should be 60 feet at all other points.

Total Vehicles Served.

Maximum Traffic.

Right of Way.

The Board has further decided that the right of way, excepting through the congested part of Jersey City, where the highway is depressed, should be 100 feet.

TYPE OF PAVEMENT.

Granite Block Pavement.

The Board recommends that a granite block pavement, on concrete base, be used for the pavement on the recommended line. Considering the character of traffic, it is believed that this will give a longer life per unit of cost than any other pavement type.

HIGH BRIDGES, LOW BRIDGES, TUNNELS.

Alternates Over Rivers.

Three methods of accomplishing the crossing of the Hackensack and Passaic Rivers have been given consideration by the Board, namely, bridges at or about the level of the present structures; bridges having a 40-foot underclearance; and by the construction of tunnels.

As previously stated in this report, traffic with bridges at the present level is held up approximately 10.4 per cent of the time, as shown on page No. 22. The total time lost to vehicles at the Passaic River is 3,528 minutes per day. Economists figure the value of time of a motor vehicle at 5 cents per minute and upward. Capitalizing the 3,528 minutes lost daily, at 5 per cent per year, justifies a capital expenditure of $1,288,085.00. The tabulation and calculation given is based on present conditions. With the increase in traffic, which has been estimated, this capitalized amount will be increased to approximately $5,000,000.00.

The tabulation on page No. 24 shows the character of craft passing through the bridges.

The separation of the special classes of vessels noted was made in order to separate those with masts or upper works requiring more than 40-foot clearance from water level. It should be noted that 78 per cent of the openings on the Hackensack River are for vessels requiring more than 40-foot clearance, while only 42 per cent is the case on the Passaic River. It should also be noted that the total number of openings on the Hackensack River is less than that on the Passaic so that the number

River Traffic.

of openings for the special class of vessels listed is not widely different in the two cases. It should also be observed, however, that traffic on the Hackensack river has been increasing while that on the Passaic River has been decreasing. A special investigation was made of the actual heights above water level to which lighter masts, tug boat funnels, and the upper works of various other kinds of vessels extend. The results are shown on the diagram on page 25. The statistics cover only the vessels actually noted on an inspection trip along the banks of both rivers and the proportions do not correspond accurately to the number of vessels to pass through either drawbridge.

Bridge Clearance.

It is to be noted, however, that a 40-foot bridge elevation will clear the highest tug boat smokestack and all barges and scows. The establishment of movable bridge floors at higher clearances than 40 feet does not seem economically sound, but the additional cost of constructing the bridges with 40-foot under-clearance over that of bridges at approximately the present level is amply justified.

TUNNELS.

Tunnel Location.

The general location for the proposed tunnel crossing linking the Hudson River Vehicular Tunnel with the road system of the State is on a direct line from the foot of Broadway, Jersey City, to the point where the present Lincoln Highway passes under the Penna. R. R., in the vicinity of Newark. The limiting grade in both directions might have to be slightly in excess of the maximum grade as fixed by the viaduct approach to Jersey City, due to excessive cost on the west approach of the Passaic River, where expensive work exists, due

Tunnel Grades.

to the crossing under the P. R. R. embankment. It is believed, however, that it can be accomplished without this excessive cost, and with a maximum grade of 4 per cent. Provision has been made for future dredging

plane 35 feet below mean low water, which is probably in excess of the War Department requirements.

The Board has had the advice of one of its members, the Chief Engineer of the Bridge and Tunnel Commission, in the consideration of the proposed tunnel, and the preparation of estimates of cost.

ROUTES.

1. *Jersey City—Elizabeth.*

The selection of the route between the entrance to the tunnel and the westerly outskirts of Elizabeth, on Route No. 1, was given very careful study and consideration, and it is believed to represent the best route which can be selected, giving due weight to the economics involved. The route has been divided into six (6) sections, on three of which alternates appear to have sufficient importance to justify their submission to the Commission with comparative estimates of cost.

Section No. 1.

Section No. 1 is 2,500 feet in length, and consists of a viaduct from Jersey Avenue, via Twelfth Street, to the high ground in Jersey City.

Section No. 2 and 2A.

Section No. 2 and 2A is 7,400 feet in length, and extends from the end of the viaduct to the foot of Broadway, in Jersey City. Alternate estimates are submitted covering subway construction from the end of the viaduct to Tonnelle Avenue, and thence by the surface to the foot of Broadway; and for surface construction over the whole length, with the exception that undercrossings are made at Baldwin Avenue and the Hudson Boulevard. In either case, the necessary ramps to provide for traffic entering upon and leaving the highway are provided at both Baldwin Avenue and the Hudson Boulevard. The route between the end of the viaduct and Tonnelle Avenue is largely over private right of way to be acquired, and where not on private right of way between these points it has been assumed that the

City will vacate the streets in the event the open-cut type of construction were adopted.

Through Jersey City.

It is believed that the route is the most direct that can reasonably be secured through Jersey City, that the type of development through which the line passes is such that property damage is minimized to the greatest possible extent, and that even though the open-cut type of construction is used, adequate facilities for meeting the needs of Jersey City traffic in connection with the highway have been provided for.

Section No. 3.

Section No. 3 is 13,000 feet in length. This is a straight line from Jersey City to Newark, across the meadows. This route is the shortest possible between the two points, and effects a saving in distance of some 3,900 feet over Section No. 3A. The line consists almost entirely of meadow fill for which all of the excavation from the Jersey City open cut is available. It has the advantage of being free from trolley tracks, which would not be the case if Section No. 3A were used.

It is believed ample provision has been made in the estimates for additional quantities which may be required to do the work, due to subsidence and shrinkage of embankments across the meadows.

Section No. 3A.

Section No. 3A runs from the foot of Broadway to the crossing of the Lincoln Highway, at the Pennsylvania Railroad, in Newark, and is 16,900 feet in length. This route involves the construction of about 8,000 feet of embankment to connect the foot of Broadway with the Lincoln Highway, and thence by the Lincoln Highway to Newark. It would involve the reconstruction of the present Hackensack and Passaic River bridges, or the construction of new bridges. It would also necessitate the widening of the present Lincoln Highway and presents the complication of having to take care of trolley traffic over the bridges. The trolley company

has a perpetual right over this highway and these bridges.

Section No. 4.

Section No. 4, from Newark Plank Road to Weston Avenue, is 22,200 feet. This section lies entirely without the congested section of Newark, and yet is readily accessible thereto, as it will likewise be to the developments projected by the railroads in connection with the Port development now under consideration. It lies for a considerable part of its length immediately adjoining and parallel to the tracks of the Pennsylvania Railroad Company, and right of way will have to be acquired at this point. Through London Street, it is believed that satisfactory arrangements can be made with the city for the vacation of this street, and from that point westerly advantage has been taken of the meadow fill which the City of Newark has already made. Advantage will also be taken of the contract which the City of Newark has with the Lehigh Valley Railroad for the viaduct over the Oak Island Yard.

Section No. 5.

Section No. 5, via Carnegie, McClellan, King to North Avenue, Elizabeth, is 16,900 feet long. This section of the route lies largely over private right of way to be acquired across meadow land. The underpass under the Pennsylvania Railroad will have to be widened, and in order to eliminate the grade crossing at Frelinghuysen Avenue an underpass will have to be built at that point. This route is somewhat longer than Section No. 5A, but has the advantage that it does not interfere with the park development in Weequaic Park, and the property damage will be considerably less.

Section No. 5A.

Section No. 5A is on a line via Dayton Avenue. The distance of this section is 15,500 feet. The construction of this route would involve building a viaduct over the Pennsylvania Railroad Waverly Yards, and also over Frelinghuysen Avenue, and the acquiring of certain of the property now forming part of Weequaic Park. The curvature on this line is more objectionable than on

Section No. 5, and it affects adversely more highly developed property than does Section No. 5.

Section No. 6.

Section No. 6, running from North and Irvington Avenues to Elmora Avenue, in Elizabeth, is 4,200 feet in length, and from the intersection with Elmora Avenue to Rahway Avenue is 5,400 feet, or a total length of 9,600 feet. This route occupies the above named streets and affords an easy connection with State Highway Routes Nos. 1 and 9.

2. Jersey City—North.

Tonnelle Avenue.

The route and construction necessary to provide for the traffic proceeding north and northwest of Jersey City includes the reconstruction and extension of Tonnelle Avenue to the route described in the statute as Route No. 18, or locally known as the Bergen Turnpike, and thence along the Bergen Turnpike northerly (Route No. 18) to Route No. 10, located in Bergen County. This route would connect with what is known as Edgewater Crossing, in Ridgefield.

Route No. 18.

Paved Width.

The proposed width of pavement on this highway would be 40 feet, and the pavement recommended is granite block pavement on a concrete base.

A considerable part of the work involved in this section will come within the regular State highway construction program, and such cost is not included in the total cost shown on estimates given later in this report.

Jersey City North.

For the accommodation of traffic, proceeding north, immediately from the entrance to the tunnel to Hoboken and the river front in that vicinity, the widening and improvement of Henderson and Grove Streets would be desirable. It has seemed to the Board, however, that this is a local condition which should be taken care of by the municipalities involved.

ESTIMATES.

Estimates on the above mentioned routes, route sections and alternatives are made up as follows, including engineering and contingencies:

ESTIMATE OF QUANTITIES AND COSTS.

Route No. 1 Extension—Vehicular Tunnel Entrance to Elizabeth.

Section No. 1.—Jersey Avenue to Palisade Avenue, via Twelfth Street. Distance, 2,500 feet.

Description.	*Quantities.*	*Estimate.*
Twelfth St. Viaduct,	2,500 x 50′	$975,000.00
Right of Way (assumed Erie will grant easement).		
		$975,000.00
Contingencies, 10%,		97,500.00
Engineering, 5%,		48,750.00
Total,		$1,121,250.00

Section No. 2.—Palisade Avenue to Broadway and Halleck Street. Length, 7,400 feet.

(Under Palisade Ave.—Grade at Baldwin; Under Hudson Boulevard—Grade at P. R. R. Crossing.)

Description.	*Quantities.*	*Unit.*	*Estimate.*
Excavation (rock) open cut at Palisade and Hudson Boulevard,	55,000 cu. yds.	$10.00	$550,000.00
Excavation (earth) consisting of block paving and street widening on Broadway,	9,000 cu. yds.	2.00	18,000.00
Pavement—Granite block on concrete base, 50′ wide in cut, 2,300 ft.,	12,800 sq. yds.	7.50	96,000.00
Pavement—Granite block on concrete, 60′ wide on surface exclusive of bridge over P. R. R., 4,900 ft.,	32,700 sq. yds.	7.50	245,250.00
Street intersections,	2,000 sq. yds.	7.50	15,000.00
Drainage structures,	Lump sum.		50,000.00
Moving substructures,	Lump sum.		50,000.00
Retaining walls at top of cut,			100,000.00
Curbing (grante),	10,400 lin. ft.	2.50	26,000.00
Right of way,			1,250,000.00
Overhead bridge at Palisade Avenue,	60 x 50′		68,000.00
Overhead Bridge at Hudson Boulevard,	100 x 50′		115,000.00
Bridge over P. R. R. cut,	200 x 50′		110,000.00
			$2,693,250.00
Contingencies, 10%,			269,325.00
Engineering, 5%,			134,662.50
			$3,097,237.50

Section No. 2A.—Same location as Section No. 2, but in open cut from Palisade Avenue to P. R. R., with approach ramps at Baldwin Avenue and Hudson Boulevard. Length, 7,400 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Excavation (rock) in open cut, 50′ wide and approach ramps with slopes ¼ to 1,	160,000 cu. yds.	$9.00	$1,440,000.00
Excavation (earth), etc., on Broadway,	9,000 cu. yds.	2.00	18,000.00
Pavement, granite block, 50′ wide in cut, 3,700 feet,	20,600 sq. yds.	7.50	154,500.00
Pavement, granite block, 60′ wide on surface, exclusive of bridge over P. R. R., 3,500 feet,	23,400 sq. yds.	7.50	175,500.00
Street intersections and ramps,	6,000 sq. yds.	7.50	45,000.00
Curbing (granite),	7,000 lin. ft.	2.50	17,500.00
Drainage structures,			50,000.00
Retaining walls,			200,000.00
Moving substructures,			150,000.00
Right of way,			1,250,000.00
Bridge at Palisade Avenue,	60 x 50′		68,000.00
Bridge at Baldwin Avenue,	60 x 50′		68,000.00
Bridge at Oakland Avenue,	60 x 50′		68,000.00
Bridge at Cook Avenue,	35 x 50′		40,000.00
Bridge at Elevated Railway,	60 x 50′		68,000.00
Bridge at Newark Avenue,	70 x 50′		80,000.00
Bridge at Summit Avenue,	60 x 50′		68,000.00
Bridge at Hudson Boulevard,	100 x 50′		115,000.00
Bridge at P. R. R.,	200 x 50′		110,000.00
			$4,185,500.00
		Contingencies, 10%,	418,550.00
		Engineering, 5%,	209,275.00
			$4,813,325.00

Section No. 3.—Jersey City-Newark, Meadow Location. Length, 13,000 feet.

(Using Excavation from Section 2 in embankment.)

HIGH BRIDGES AND LOW BRIDGES.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment, 13,000 feet, less 3,000 ft. for bridges, 80′ wide on top, 7′ high, with 120% allowed for subsidence,	519,000 cu. yds.		
Allow excavation from Section No. 2, with 1.7 as estimated swell in rock cut, 64,000 x 1.7,	108,000 cu. yds.		
Borrow (with low bridge and Section No. 2 excavation),	411,000 cu. yds.	$1.00	$411,000.00

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment, total, ...	519,000 cu. yds.		
Excavation from Section 2A, with allowance of 1.7 for swell in rock cut, 169,000 x 1.7, ...	287,000 cu. yds.		
Borrow, with low bridges and Section 2A excavation, ...	232,000 cu. yds.	1.00	232,000.00
Embankment for 4 high bridges, approaches, allowing 50% for subsidence, ...	487,500 cu. yds.		
Borrow, with high bridges and Section 2:			
519,000 cu. yds.			
487,500 cu. yds.			
1,006,500 cu. yds.			
Deduct: 108,000 cu. yds.	898,500 cu. yds.	1.00	898,500.00
Borrow, with high bridges and Section 2A:			
1,006,500 cu. yds.			
Deduct: 287,000 cu. yds.	719,500 cu. yds.	1.00	719,500.00
Pavement, 10,000′ x 60′, ...	67,000 sq. yds.	$7.50	$502,500.00
Curbing, ...	20,000 lin. ft.	2.50	50,000.00
Right of way (meadow land), ...			150,000.00
Drainage, ...			50,000.00
Bridge at Passaic River, 28′ clearance, ...			1,345,000.00
Bridge at Passaic River, 40′ clearance, ...			2,000,000.00
Bridge at Hackensack River, 28′ clearance, ...			2,477,000.00
Bridge at Hackensack River, 40′ clearance, ...			3,250,000.00
Connection between Passaic River Bridge and present Lincoln Highway, 1,000′:			
Borrow, ...	51,000 cu. yds.	1.00	51,000.00
Pavement, ...	6,700 sq. yds.	7.50	50,250.00
Curbing, ...	2,000 lin. ft.	2.50	5,000.00
Total for connection, ...			$106,250.00

SUMMARY (INCLUDING CONNECTION).

Low bridges and Section No. 2, ...		5,091,750.00
Low bridges and Section No. 2A, ...		4,912,750.00
High bridges and Section No. 2, ...		7,007,250.00
High bridges and Section No. 2A, ...		6,828,250.00
Contingencies,	10%	682,825.00
Engineering,	5%	341,412.50
Total high bridges and Section No. 2A, ...		$7,852,487.50

Section No. 3.—Hackensack-Passaic Tunnel Location. Length, 13,000 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment—5,000′ long, 80′ wide, 7′ high, 120% allowed for subsidence, is	257,000 cu. yds.		
With Section No. 2,	108,000 cu. yds.		
	149,000 cu. yds.	$1.00	$149,000.00
With Section No. 2A,	(None required.)		
Pavement,	33,400 sq. yds.	7.50	250,500.00
Curbing,	10,000 lin. ft.	2.50	25,000.00
Drainage,			50,000.00
Right of way,			150,000.00
Tunnels, Passaic River, 3,550 ft., 2 tunnels,			6,100,000.00
Tunnels, Hackensack River, 3,700 ft., 2 tunnels,			6,400,000.00
Depressed approaches to tunnels (includes retaining walls, floor slabs, excavation and paving),	2,200 ft.	500.00	1,100,000.00

SUMMARY.

Tunnels with Section No. 2,	$14,224,500.00
Tunnels with Section No. 2A,	14,075,500.00
Contingencies, 10%,	1,407,550.00
Engineering, 5%,	703,775.00
Total Tunnels with Section No. 2A,	$16,186,825.00

Section No. 3A.—Broadway, via Halleck and Marcy Streets, to present Lincoln Highway, and by same to P. R. R. in Newark. Length, 16,900 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment, Broadway to Lincoln Highway, 80′ wide, allowing 50% for subsidence,	90,000 cu. yds.		
Used with Section No. 2 no borrow would be required.			
Embankment for high bridges, allowing 50% subsidence,	487,500		
	577,500		
With high bridges and Section No. 2, deduct,	108,000		
	469,500 cu. yds.	$1.00	$469,500.00
With highway bridges and Section No. 2A, deduct,	287,000		
	290,500 cu. yds.	1.00	290,500.00
Pavement, 14,900 x 60′,	99,400 sq. yds.	7.50	745,500.00
Curbing,	12,000 lin. ft.	2.50	30,000.00
Curbing, reset,	17,800 lin. ft.	1.00	17,800.00
Drainage,			30,000.00
Right of Way,			75,000.00
Bridge over outlet from city park,			5,000.00
Bridge over Hackensack River, 28′ cl.,			2,477,000.00

Bridge over Hackensack River, 40′ cl.,	3,250,000.00
Bridge over Passaic River, 28′ cl.,	1,345,000.00
Bridge over Passaic River, 40′ cl.,	2,000,000.00

SUMMARY.

Low Bridges and Section 2, or 2A,		$4,725,300.00
High Bridges and Section 2,		6,622,800.00
High Bridges and Section 2A,		6,443,800.00
Contingencies,	10%,	644,380.00
Engineering,	5%,	322,190.00
Total,		$7,410,370.00

Section No. 4.—Newark Plank Road to Weston Ave. Length, 22,200 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Excavation (earth),	55,000 cu. yds.	$1.50	$82,500.00
Borrow (earth and cinders),	500,000 cu. yds.	1.25	625,000.00
Pavement (granite block on concrete), 19,200 x 60′,	128,000 sq. yds.	8.00	1,024,000.00
Curbing, granite,	38,400 lin. ft.	2.50	96,000.00
Drainage,			100,000.00
Right of way,			300,000.00
Bridge over C. R. R. Mfs. Branch, 60 x 50′,			68,000.00
Bridge over Plum Point Road, 75 x 50′,			130,000.00
Bridge over C. R. R. (New York Branch),			300,000.00
			$2,725,500.00
Contingencies,		10%	272,550.00
Engineering,		5%	136,275.00
Total,			$3,134,325.00

Section No. 5.—Carnegie, McClellan, King to North Ave., Elizabeth. Length, 16,900 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment on Carnegie Ave., 5,800 x 80′ x 7′, allowing 75% subsidence,	237,000 cu. yds.		
Less 74,000 cu. yds. available from cut,	74,000 cu. yds.		
	163,000 cu. yds.	$1.25	$203,750.00
Excavation,	92,300 cu. yds.	1.50	138,450.00
Pavement, granite blocks:			
15,100 x 60′,	100,700 sq. yds.		
1,800 x 50′,	10,000 sq. yds.		
900 x 20′ ramps,	2,000 sq. yds.		
	112,700 sq. yds.	8.00	901,600.00
Curbing,	30,200 lin. ft.	2.50	75,500.00
Retaining walls,	4,000 cu. yds.	15.00	60,000.00
Drainage,			25,000.00
Right of way,			450,000.00

Bridges:

Bridge over P. R. R. single track, 50 x 20′,	30,000.00
Bridge over P. R. R. four-track, 50 x 60′,	68,000.00
Underpass at Frelinghuysen Avenue, 50 x 100′,	115,000.00
	$2,067,300.00
Contingencies, 10%	206,730.00
Engineering, 5%	103,365.00
Total,	$2,377,395.00

Section No. 5A.—Intersection Weston and Carnegie Avenue, via Dayton Avenue, to North Avenue in Elizabeth. Distance, 15,500 feet.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Embankment, extending approach grades to viaduct over P. R. R., 16,900 cu. yds. to be made with excavated material.			
Excavation,	58,000 cu. yds.	$1.50	$87,000.00
Pavement, 13,000 x 60′,	87,000 sq. yds.	8.00	696,000.00
Curbing,	26,000 lin. ft.	2.50	65,000.00
Drainage,			25,000.00
Viaduct over P. R. R. (Waverly Yards), 1,200 x 50′,			470,000.00
Bridge, including viaduct over Frelinghuysen Avenue, 1,200 x 50′,			538,000.00
Ramps at Frelinghuysen Avenue,			100,000.00
Right of way,			150,000.00
			$2,131,000.00
Contingencies, 10%			213,100.00
Engineering, 5%			106,550.00
Total,			$2,450,650.00

Section No. 6.—North and Irvington Avenues to Elmora Avenue, in Elizabeth, length, 4,200 feet, and from intersection with Elmora Avenue to Rahway Avenue, length, 5,400 feet. Total length, 9,600 feet.

NORTH AVENUE ESTIMATE.

Description.	*Quantities.*	*Unit.*	*Estimate.*
Excavation,	15,700 cu. yds.	$1.50	$23,550.00
Pavement, granite blocks, 4,200 x 60′,	28,000 sq. yds.	8.00	224,000.00
Curb,	8,400	2.50	21,000.00
Drainage,			20,000.00
Right of way,			50,000.00
			$338,550.00
Lump sum estimate to carry to Rahway Avenue,			150,000.00
			$488,550.00
Contingencies, 10%			48,885.00
Engineering, 5%			24,427.50
Total,			$561,832.50

JERSEY CITY CONNECTING LINKS—NORTH AND NORTHWEST.

Tonnelle Avenue and State Highway Route 18.

HUDSON COUNTY—33,000 FEET.

Description.	*Estimate.*
Grading and Drainage,	$300,000.00
Paving—Granite Block,	1,098 750.00
Curbing,	165,000.00

BERGEN COUNTY—8,000 FEET.

Grading and Drainage,	60,000.00
Paving and Curbing,	200,000.00
	$1,823,750.00
Contingencies, 10%	182,375.00
Engineering, 5%	91,187.50
	$2,097,312.50
Less work now embraced in State Highway program,	750,000.00
	$1,347,312.50

RECOMMENDATIONS.

As regards Route No. 1 extension, the Advisory Board respectfully recommends the selection of the following sections as representing the route and type of construction best fulfilling the requirements laid down in the resolution of the State Highway Commission, namely:

	Estimate.
Section No. 1. Jersey Avenue to Palisade Avenue, Viaduct via Twelfth Street,	$1,121,250.00
Section No. 2A. Palisade Avenue to Broadway and Halleck Street, in open cut from Palisade Avenue to P. R. R., with approach ramps at Baldwin Avenue and Hudson Boulevard,	4,813,325.00
Section No. 3. Jersey City to Newark over the Meadow location, using tunnels under the Hackensack and Passaic Rivers,	16,186,825.00
Section No. 4. Newark Plank Road to Weston Avenue,	3,134,325.00
Section No. 5. Carnegie Avenue, McClellan Street, King Street to North Avenue, Elizabeth. Undercrossing at Frelinghuysen Avenue,	2,377,395.00
Section No. 6. North and Irvington Avenue, to Elmora Avenue, to Rahway Avenue,	561,832.50
Total Route No. 1,	$28,194,952.50
Bergen County Connecting Links,	1,347,312.50
Grand Total,	$29,542,265.00

It is to be noted from the estimate sheets included in this report that if the bridges using an underclearance of 40 feet are used, instead of tunnels, the above estimated amount would be reduced by $8,334,337.50.

ROUTES.

As regards the connection with the Paterson Plank Road and Route No. 18, the Board recommends the widening, reconstruction and extension of Tonnelle Avenue to an intersection with Route No. 18, and thence along the Bergen Turnpike to Route No. 10.

WIDTH OF ROADWAY.

The width of roadway recommended on Route No. 1 Extension is a minimum of fifty (50) feet, to be used where parking of automobiles will not be permitted, namely on viaduct and in open cut, and sixty (60) feet at all other places.

On the extension to the north, a width of roadway of forty (40) feet is recommended.

GRANITE BLOCK PAVEMENT.

A granite block pavement on concrete base is recommended for all the above construction.

CONSTRUCTION NECESSARY.

The tentative date fixed for the completion of the vehicular tunnel is 1926. Attention is called to the fact that if these highways are to be ready to receive the traffic on the opening of the tunnel, it is essential that construction be started at the earliest possible moment. The construction of tunnels under the Hackensack and Passaic rivers will occupy all the intervening time, and it is particularly desirable that in the case of meadow fills, as much time as possible be given for the settlement of same before placing permanent paving thereon.

RIGHT OF WAY.

It is also to be noted that the large amount of right of way to be acquired through Jersey City will take considerable time and

the removal of rock incident to the construction of the open cut is also an operation which would delay the opening of this highway beyond the completion of the tunnel, if it is not started at an early date.

Respectfully submitted,

Chairman

PROPOSED HIGHWAY FROM VEHICULAR TUNNEL AT JERSEY CITY.

PROPOSED VIADUCT LOCATION

— KEY —

SECTION	DESCRIPTION	LENGTH
NO. 1	JERSEY AVE TO PALISADE AVE	2500 FT
" 2	PALISADE AVE TO BROADWAY & HALLECK ST (ON SURFACE)	7400 FT
" 2A	PALISADE AVE TO BROADWAY & HALLECK ST. (SUBWAY.)	7400 FT
" 3	JERSEY CITY TO CITY OF NEWARK. (MEADOW LINE)	13000 FT
" 3A	JERSEY CITY TO CITY OF NEWARK. (MARCY AVE & LINCOLN HIGHWAY)	16400 FT
" 4	LINCOLN HWY TO WESTON AVE	22200 FT
" 5	WESTON AVE, CARNEGIE AVE, MC CLELLAN AVE TO NORTH AVE	16400 FT
" 5A	WESTON AVE, DAYTON AVE, TO NORTH AVE	15500 FT
" 6	NORTH AVE, ELMORA AVE TO RAHWAY AVE (STATE HWY ROUTE NO 1)	9600 FT

Note:- The various sections are shown by numbers in circles (4)

— SCALE —

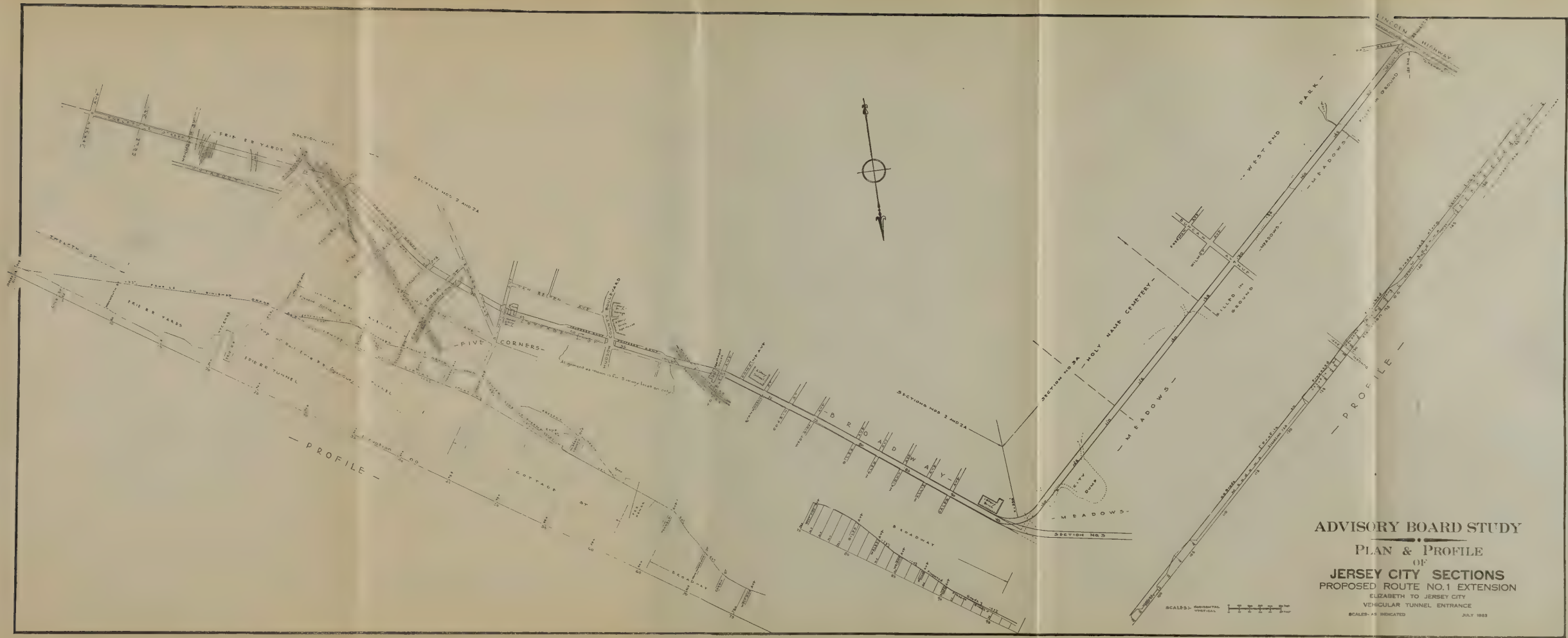
TOTAL LENGTH
RECOMMENDED LINE = 13.5 MILES.
ALTERNATE LINE = 13.9 MILES.

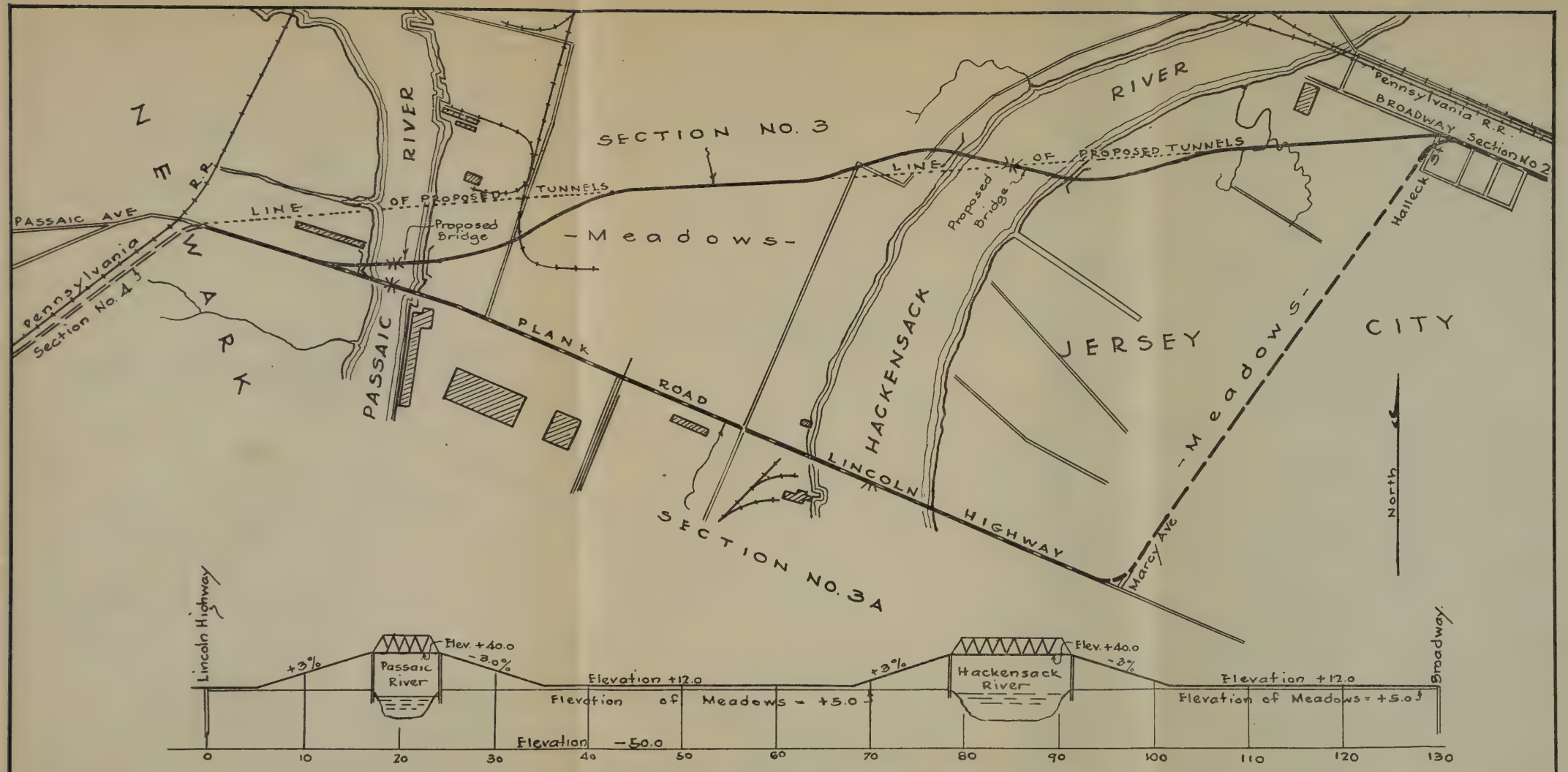
ADVISORY BOARD STUDY

KEY MAP

PROPOSED ROUTE 1 EXTENSION
ELIZABETH TO JERSEY CITY
VEHICULAR TUNNEL ENTRANCE

SCALES:- AS INDICATED — JULY 1923


ERIE RR YARDS
SECTION NO. 1
SECTIONS NOS 2 AND 2A
TWENTY-SECOND ST.
ERIE RR YARDS
ERIE RR TUNNEL
— PROFILE —
— FIVE CORNERS —
HUDSON COUNTY BOULEVARD
— BROADWAY —
SECTIONS NOS 2 AND 2A
SECTION NO. 3
— BROADWAY —
SECTION NO 2A
— HOLY NAME CEMETERY —
— MEADOWS —
— WEST END PARK —
— MEADOWS —
— MEADOWS —
— PROFILE —
ADVISORY BOARD STUDY
PLAN & PROFILE
OF
JERSEY CITY SECTIONS
PROPOSED ROUTE NO. 1 EXTENSION
ELIZABETH TO JERSEY CITY
VEHICULAR TUNNEL ENTRANCE
SCALES:- AS INDICATED
JULY 1923

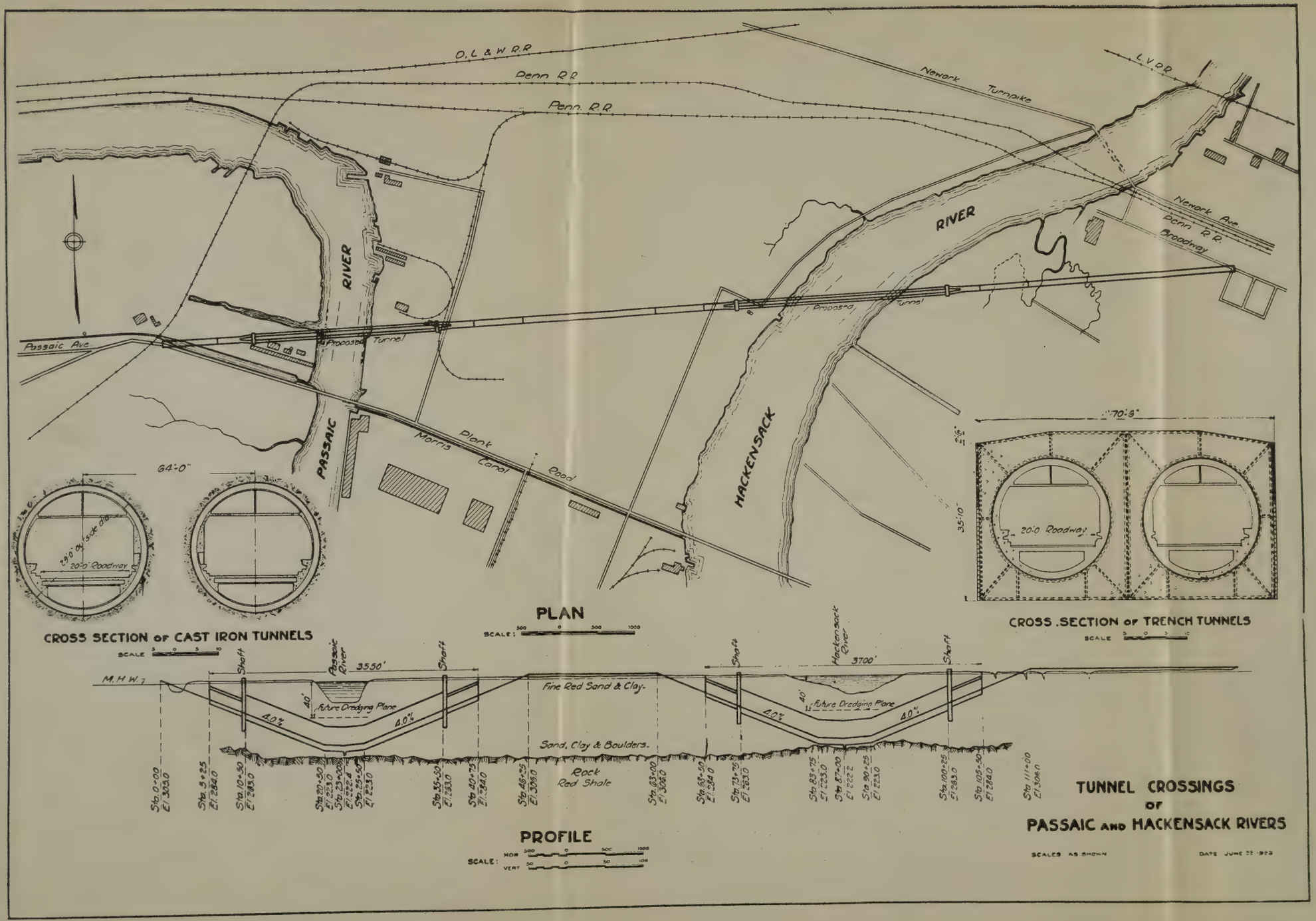


— PROFILE.- SECTION NO. 3 —

Scales:- Hor. 500 0 500 1000 1500 2000
Vert. 50 0 50 100 150 200

ADVISORY BOARD STUDY
PLAN AND PROFILE
SECTIONS 3 AND 3A
— PROPOSED ROUTE 1 EXTENSION, —
ELIZABETH TO JERSEY CITY.
* VEHICULAR TUNNEL ENTRANCE.

Scales as shown. July 20, 1923.

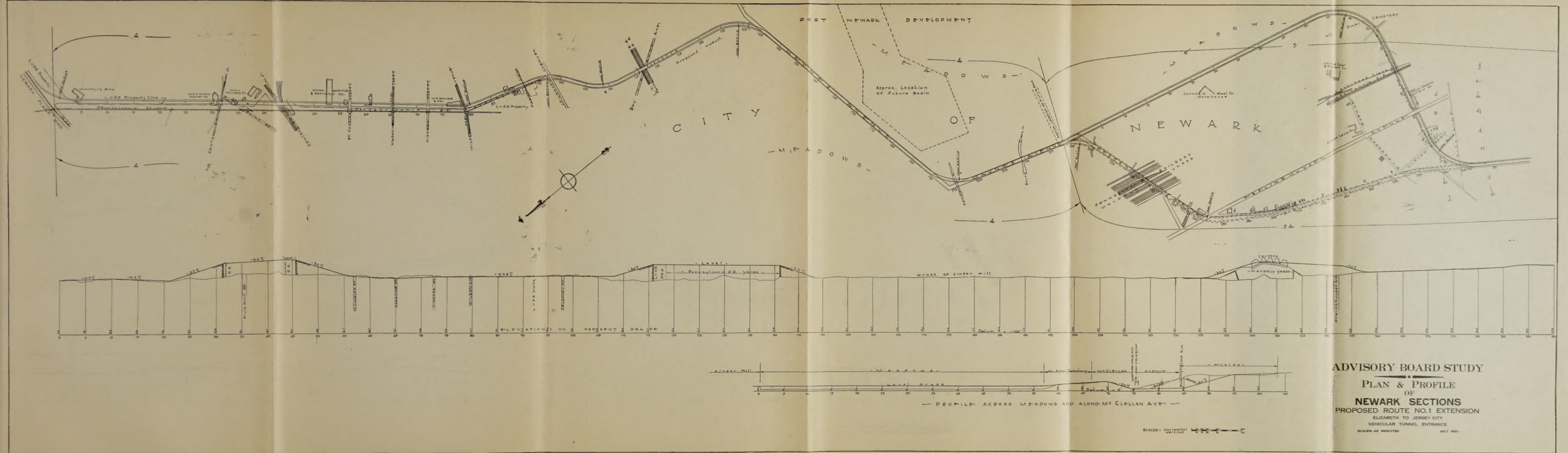


TUNNEL CROSSINGS OF PASSAIC AND HACKENSACK RIVERS

SCALES AS SHOWN

DATE JUNE 22 1923

VITIATED AIR
FRESH AIR
FULL SIZED SECTION
0196



ADVISORY BOARD STUDY

PLAN & PROFILE OF NEWARK SECTIONS

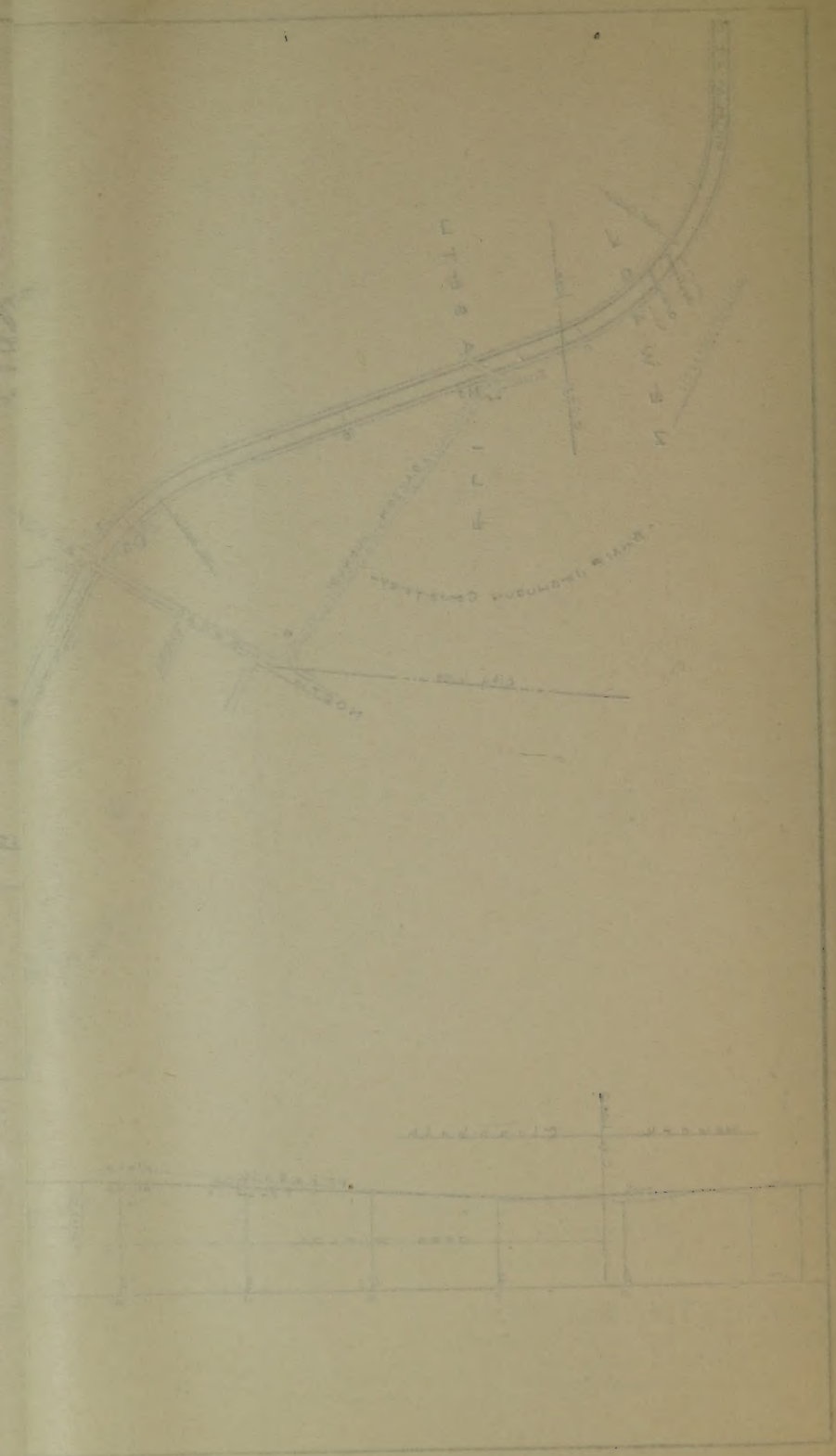
PROPOSED ROUTE NO. 1 EXTENSION

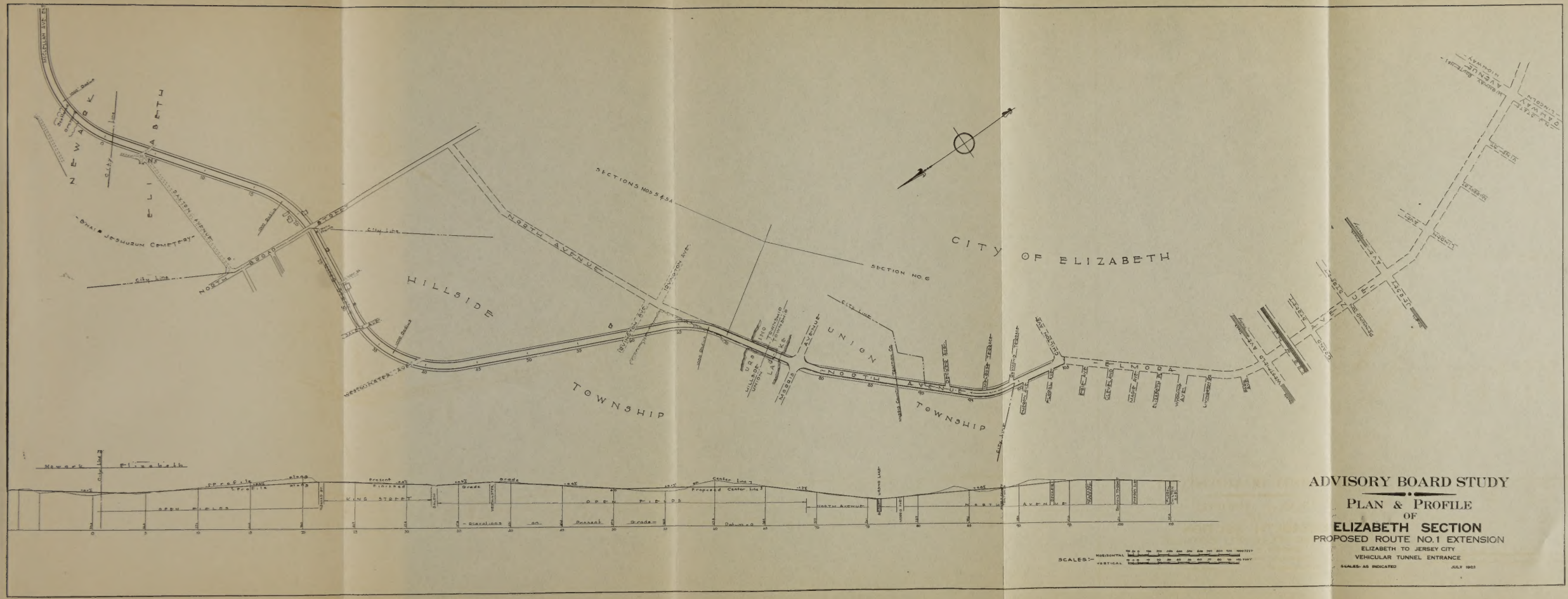
ELIZABETH TO JERSEY CITY

VEHICULAR TUNNEL ENTRANCE

SCALES AS INDICATED

JULY 1933





ADVISORY BOARD STUDY

PLAN & PROFILE OF ELIZABETH SECTION

PROPOSED ROUTE NO. 1 EXTENSION

ELIZABETH TO JERSEY CITY

VEHICULAR TUNNEL ENTRANCE

SCALES AS INDICATED JULY 1923

HUDSON AVE
CENTRE LINE